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OFFICIAL ORGAN OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

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Proceedings of the Twenty-first Annual Meeting of the American Association of Economic Entomologists

(Continued from April number)

PRESIDENT FORBES: If there is no further discussion, the next paper will be "Notes of the Year from North Carolina," by Mr. Sherman.

NOTES OF THE YEAR (1908) FROM NORTH CAROLINA

By FRANKLIN SHERMAN, JR., *Raleigh, N. C.*

While the great majority of the complaints that have reached my office during the year just closing have been of species already widely known, yet there have been a number that have, in some way, more than usual interest.

In March a complaint (with specimens) was received from Wilmington, in the southeastern part of the state, of a species of "mite" or "flea," which was proving very troublesome by burrowing into the skins of persons. They were reported as being very abundant all over the ground, under the house, in the stables, and in chicken-coops. Specimens were at once forwarded to Prof. Herbert Osborn of the Ohio State University, who identified it as the Chicken Flea (*Xestopsylla* (*Sarcopsylla*) *gallinacea*), which he says has been troublesome in Florida and Texas for a number of years, but which had not previously been recorded north of South Carolina. Evidently this creature is extending its range and may eventually inhabit all the warm sandy coast districts. This flea was discussed in the December

issue of the JOURNAL OF ECONOMIC ENTOMOLOGY, in an article by Professor Herrick.

The Strawberry Weevil (*Anthonomus signatus*) again did serious damage in the spring in the southeastern part of our state, where the strawberry is an important crop. A number of years ago we demonstrated at least the *futility* of a number of supposed remedies, and as the favorite varieties of early berries are principally pollen-bearing sorts, growers do not take readily to the suggestion to use pistillate varieties.

The Cabbage Louse (*Aphis brassicae*) is a serious pest with us almost every spring. The insect seems to pass the winter in all stages, in small (or large) colonies on the leaves of fall-set cabbage, or on winter collards (a cruciferous crop peculiar to the south) and multiply abundantly when warm spring weather comes. We have found that complicated emulsions of kerosene, with the necessary care as to exact proportions of oil and water, are not at all necessary. Any ordinarily strong laundry soap shaved in thin pieces and dissolved in boiling water and then diluted to 1 pound of soap to 3 gallons of water is an entirely satisfactory remedy. One grower even wrote me that water filtered through a barrel of wood ashes extracted enough lye so that it was effectual, but I am not able to positively confirm this.

And right here let me say a word for simplicity. The average farmer, trucker, or fruit-grower (at least in North Carolina) is not disposed to prepare and use remedies in which special care has to be used to get proportions exact and where there are also many ingredients. We need to remember that an entomologist in the zeal of his experiment can easily procure all sorts of substances, and use methods of exactness, which the ordinary farmer will not, and in most cases cannot, use. We blissfully recommend "kerosene emulsion at the strength of 25% oil" for this, or "at rate of 15% oil" for that, and yet we must know that not one man in a dozen to whom we make these suggestions actually goes to the trouble of preparing the emulsion and testing the advice. In this I believe that my experience is not different from that of other entomologists. The simpler the process of preparing a remedy, the fewer the ingredients, and the easier they may be obtained the better, even though it may kill a less percentage of the offending insects.

In the latter part of March I received complaint of a species of "little brown cricket," which, to quote from my correspondent:

"Piles up dirt at his hole like an ant, and promises to give a lot of trouble with tobacco and other plants that are transplanted. They cut the plants off and pull them in the ground. I see that they are

more plentiful than I ever saw them before in land that I want to plant in tobacco. I have some cabbage that they are cutting off now."

A later letter from the same party said that "they live deep in the clay and come out at night to do their destruction."

Upon securing specimens it was found that the culprit was the cricket *Anurogryllus muticus*, of which we had never before had complaint and which was only meagerly represented in our collections. The burrowing habit of the species is discussed by Rev. A. H. Manee (of Southern Pines, N. C.) in the December issue of *Entomological News*.

From time to time ever since I have been in North Carolina I have heard vague reports of a "Root-louse" or "Blue-bug" which was said to attack roots of cotton. The reports always indicated that it was a serious pest, but they always reached me at such times or in such manner that no specimens were available. Only the persistency of the reports kept me from assigning them to the scrap-pile of entomological fallacies. The year 1907 brought out an unusual crop of reports, but in no case could I get specimens. I determined, however, to lay plans for at least determining the identity of the pest in 1908, and, accordingly, last spring sent out a circular letter to numerous growers saying that even the identity of the insect was yet in doubt and asking their aid in ferreting out the culprit. As a consequence we definitely determined that the species concerned is *Aphis maidi-radicis* Forbes, famous as the Corn Root-aphis of the Central States. We found, too, that in the cotton-fields of North Carolina it is commonly attended by the ant *Lasius aliena* Forst, which is considered to be a variety of *Lasius niger*, the common ant in attendance on the Corn Root-aphis in Illinois.

Aphis maidi-radicis has not heretofore been recognized as a cotton pest. Dr. Howard wrote me that it had been once reported from South Carolina on cotton,—but no published account of it had appeared. Yet I am convinced that it is (at least in North Carolina) a cotton pest of real importance and of wide distribution. I found it in cotton fields at Raleigh where the infested plants were invariably more stunted and belated in their growth than uninfested ones nearby. Growers say that these stunted plants are likely to be caught by frost before they can mature their crop.

This insect has never been reported to me as a corn pest until the past spring when one complaint was received from a section where the Cotton Root-louse is not complained of. I cannot take time and space here to discuss further the abundance and destructiveness of the pest as revealed by my correspondents, but I have scarcely a doubt

that in eastern North Carolina it is a pest of long standing, and is one of the three or four most important insect enemies of the Cotton Crop,—perhaps the most important of all.

A beetle of the family *Chrysomelidæ*, by the name of *Luperodes brunneus*, has been given the title of "The New Cotton Beetle" by Prof. R. I. Smith, in Bulletin 20 of the Georgia State Board of Entomology. The species was reported from Georgia as a pest of cotton as early as 1892, and in 1905 was sufficiently destructive to cause its discussion in the Bulletin referred to. This same beetle did similar injury with us in 1903, 1904 and 1905,—and in the present year (1908) it was sent to me with the complaint that it was doing destruction to corn by eating the silk off clean down to the husk, and devouring the pollen from the tassels. It seems to have preference for the young flowering portions of the plants which it attacks.

The Cotton Boll-weevil, while of course far from our borders at the present time, is alleged to have appeared from time to time. About 15 distinct species of insects have been sent in on suspicion of being Boll-weevil, these proving to be everything from the species of nut-weevils (*Balaninus*) to Boll-worm and adult Lace-wing flies. The campaign of education is beginning to tell, however, and each year a larger and larger proportion of the insects sent in are of the sub-order Rhyncophora, which shows that some discrimination is being used in the complaints and inquiries.

The genuine northern Army-worm (*Heliophila unipuncta*) cropped out in destructive numbers in August not far from Raleigh where it was not thought that it would normally be destructive, although the adults occur in the fall every year. The outbreak was looked into by my assistant, Mr. Z. P. Metcalf, and the interesting studies which he made on the parasitism of the species by its usual Tachinid parasite, are recorded in the December issue of the JOURNAL OF ECONOMIC ENTOMOLOGY.

The Gloomy Scale (*Aspidiotus tenebricosus*) is a pest with us on certain varieties of maple, and more than the usual number of complaints have been recorded in 1908. Studies made by Mr. Metcalf show that it is confined principally, if not entirely, to the varieties known as Red Maple and Silver Maple, while the Sugar Maple, which is the one chiefly relied on for shade in Raleigh, is not attacked.

The Elm Beetle (*Galerucella luteola*) is destructive with us every year, chiefly in the towns in the piedmont or red-clay region between the elevations of 500 and 1,000 feet. As nearly as I can ascertain the injury began to be truly serious about 1898, but the insect is now destructive in most of our larger towns in the part of the state referred to.

Finally, I would refer briefly to a work which we only began this year in definite manner. Last year at Chicago Dr. Fernald referred to the fact that despite the efforts of the entomologists, the ravages by insects continues to increase, and called our attention to the fact,—only too painfully apparent to us all,—that only a small number of our constituents really carry our recommendations into practice.

It does seem to me that we have slipped a cog somewhere when, at this late day, we still have in every state hundreds of men who depend on apple orchards for a part of their income, and who not only do not spray, but do not believe that spraying of apples will actually pay for itself in average years! These doubters are in the majority in some of our states and I believe that we owe fully as much to the duty of *proving the facts* to these men, as to discovering newer facts and principles for the more progressive minority of our people.

During 1908 we conducted apple spraying demonstrations in six different counties in North Carolina, at one place in each county. In each case three sprayings were given, the first treatment being made the occasion of a public meeting,—a sort of field institute which was advertised throughout the county through the regular Farmers' Institute organizations. A complete barrel outfit with two leads of hose, and also a complete bucket outfit were shipped from place to place. Bordeaux Mixture and Paris Green were prepared before the audience at each place, and the spraying was done before their eyes. Three trees only were used in each test, and one of them was sprayed only on one side.

We requested a report from the owners in July to show the condition at midsummer, and again in October to show the condition at apple harvest. No effort was made to work out exact details as to percentage of wormy fruit, etc. All we wanted was to demonstrate the matter to the fruit-grower from his own everyday standpoint, and this we did. Mr. S. C. Clapp, inspector of orchards for my office, did much of this work, and he visited some of the places during the summer and said the difference between the treated and untreated trees was remarkable. The five mid-summer reports were all enthusiastic, and the five autumn reports were even more so. I have recently sent out a circular to an especially prepared list of fruit-growers of our state, describing this work and giving all these reports. If this kind of demonstration work does not take a real hold among our growers and convince them of the real value of a spray pump, I shall be disappointed.

This kind of work cannot be called research and the strictly guarded Adams' fund cannot be used for it. But I submit that while we ought

to continue to seek for new facts and new principles in our science, we must strive no less to bring the already well-known and well-established facts into the common every-day practice of a much greater number of our people.

PRESIDENT FORBES: As there are two other papers on the list of a similar character, I think we will postpone discussion until after they have been presented. The next paper will be "Entomological Notes from Georgia," by Mr. Worsham.

INSECTS OF THE YEAR IN GEORGIA

By E. L. WORSHAM, *State Entomologist*

This year, as in the past, the board has devoted most of its time to apple, peach, field and garden insects. The insects infesting the peach and apple have been the most important, and much attention has been devoted to these insects. Several new insects have been reported for the first time, as doing considerable damage. The insects which stand at the head of the list from standpoint of damage done are the various scale insects.

The San José scale (*Aspidiotus perniciosus*) is the most important insect with which we have to deal, though it may be said that it is not feared now nearly so much as it was a few years ago. Its spread over the state is very slow on account of the rigid nursery and orchard inspection maintained by the State Board of Entomology. The lime-sulfur wash is still the leading spray for this scale. In orchards where this wash has been used for four or five years the scale has been greatly reduced and the condition of the orchards much improved. For the past two years the board has conducted experiments with a number of miscible oils. Some gave very good results, but it is yet too early to say how they will succeed in the commercial orchards.

The Cherry Scale (*Aspidiotus forbesi*) has been found quite numerous in some cases, though as a rule it does not do a great deal of damage.

Peach Lecanium (*Eulecanium nigrofasciatum*) has been found in a number of orchards where spraying with lime-sulfur wash was not practised last season.

The Oyster Shell Bark Louse (*Mytilaspis pomorum*) and the Scurvy Bark Louse (*Chionaspis furfura*) were found in a few orchards and on some trees they were quite numerous. The latter was found for the first time on peach trees at Waynesboro.

The West Indian Peach Scale (*Diaspis pentagona*) was found to be quite abundant in Augusta. It was found on peach, catalpa and mulberry trees, having almost killed the peach and literally covering the mulberry trees. It was found on almost all of the mulberry trees in the lower part of the city. Steps will be taken this winter to exterminate it before it spreads into the peach orchards. It was thought last season that this scale did not exist in the state, as a search was made where it was present a few years ago, and none found. Just how and when it was introduced into Augusta is not known.

In addition to the above, the following scale insects have been found: *Aspidiotus tenebricosus*, on poplar trees, Augusta, Ga.; *Ceroplastes cirripediformis*, on hackberry trees, Augusta; and a species of *Kermes* quite common on oaks in many parts of the state.

The Gloomy Scale (*Aspidiotus obscurus*) is very common on oaks and maples. In some cases it is being kept down by the red headed fungus, but maple trees in Atlanta are being killed by this scale.

Euonymus scale (*Chionaspis enonymi*) did considerable damage during 1908, killing several hedges in Atlanta and elsewhere.

The White Fly (*Aleyrodes citri*) was more numerous during the summer than ever before. In South Georgia it was quite common on orange, California privet, umbrella trees and cape jessamine. At Darien it did some damage to the sweet and sour oranges. We have no record of any remedial measures that have thus far been tried.

The Shot-hole Borer (*Scolytus rugulosus*) was quite common this last summer, and, as in 1905, was found in some cases to attack trees that, to all appearance, were perfectly sound. At Woodbury Mr. Betts had some badly infested trees, which he saved by painting the trunks and limbs with lime-sulfur wash.

The Peach Tree Borer (*Sanninoidea exitiosa*) is still a great pest in Georgia. When mounding and worming, together with the application of a caustic wash, is practised, it does but little damage, but in neglected orchards it injures many trees. This insect is better controlled than it was a few years ago, as many have learned by dear experience that the applications of repellent washes are not effective.

Numerous orchards last fall showed the work of the Peach Twig Borer (*Anarsia lineatella*), and in some cases they seemed to be doing considerable damage. In old neglected orchards they are most common. In orchards where the lime-sulfur wash is used they do little damage.

The Plum Curculio (*Conotrachelus nenuphar*) was not so abundant as in previous years. A few orchards showed bad infestation. In one peach orchard near Woodbury it destroyed about 50% of the

peaches. This orchard had not been ploughed for two years. A few large commercial orchards were sprayed this last spring for curculio, as our experiments in 1907 gave fairly good results. In these experiments we used two pounds of arsenate of lead and three pounds of lime to fifty gallons of water. Where we sprayed twice, 69% of the fruit was sound; three times, 72% of the fruit was sound, and where we sprayed four times, 75% of the fruit was sound. On unsprayed trees there were 13 to 49% of sound fruit; or on seven unsprayed trees a general average of 30% sound. In the orchards where experiments were conducted this year there was scarcely any curculio present so we obtained no results. From the work carried on for the last three years, we have decided it is not safe to spray peaches more than twice after blooming, on account of injury to the foliage and fruit.

The Codling Moth (*Carpocapsa pomonella*) was quite abundant in unsprayed orchards. We have been conducting spraying experiments for control of this insect for the past three years, and the results will soon be published in detail, so we will only mention the work briefly. It now seems that the number of broods varies each year. In 1906 two broods and a part of a third brood were found; in 1907 nearly three complete broods; in 1908 three full and a part of a fourth brood. But it must be remembered that this was an extremely early spring, fruit blooming about ten days earlier than usual, so the Codling Moth has had a long season in which to develop.

In controlling the Codling Moth the best results were secured by spraying, once before the calyx closed, and twice for the second brood. However, very nearly as good results were secured by spraying once before the calyx closed and once for the second brood. One spraying before the calyx closed gave as good results as three sprayings applied: first, as petals fell; second, before the calyx closed; and third, ten days later. In all of these sprayings we used Disparene, two pounds; bluestone, three pounds; lime, six pounds; water, fifty gallons.

The Woolly Aphis of the apple (*Schizoneura lanigera*) was present, as usual, in many apple orchards. Some growers are now using the kerosene emulsion for this insect with very good results.

The Green-apple Aphis (*Aphis pomi*) was quite abundant in a few orchards. We are now advising the use of the tobacco decoction, or 15% kerosene emulsion for fighting this louse. To beginners in spraying we usually recommend the tobacco decoction as being the least likely to injure the trees.

The Hessian Fly (*Mayetiola destructor*) was present in many wheat

fields, but the infestation as a rule was light and no great amount of damage was done. The board has been working on this insect for several years, and in September a circular was issued giving the results thus far secured. From this study it has been found that if wheat is sown from October 20th to 30th, it will not as a rule be damaged to any great extent by the fly.

The Boll Worm (*Heliothis obsoleta*) was present in many cotton fields, but no great amount of damage reported.

The New Cotton Beetle (*Luperodes brunneus*) appeared again in June, as it did last year. The first week in July Mr. A. C. Lewis examined some fields where they had been and found that the damage in no case was very great. The beetles first appeared about June 20th, and by July 1st had disappeared. So far, we have had no chance to try poison against this insect.

The Red Spider (*Tetranychus gloveri*) was present, as it is nearly every year, in several sections of the state. In a field of ten acres near Midville it did considerable damage, and in several other sections of the state great damage was reported. For this insect we recommend dusting with sulfur. Several cotton growers dusted with sulfur and with sulfur and slaked lime, with excellent results.

Specimens of the Striped Cucumber Beetle (*Diabrotica vittata*), the common potato beetle (*Doryphora 10-lineata*), and specimens of Harlequin Cabbage Bug (*Murgantia histrionica*) were frequently received by mail during summer. During summer and early fall we received letters from several parties in South Georgia stating that the mole cricket (*Scapteriscus didactylus*) was doing a great deal of damage to garden crops. Near Darien one party was using poisoned bran mash to kill these crickets, with fairly good results.

Several times during the summer letters were received from South Georgia stating that a worm was killing cow-peas. The worms ate out the heart of the stem at, or just below, the ground. In one field near Quitman two or three acres were almost completely destroyed. When we visited the fields which they had infested we found that they had disappeared and a careful inspection showed that they had gone into the ground and were found about two or three inches below the surface. It is a lepidopterous larva, but as yet we have not succeeded in getting adults to emerge.

During the summer and early fall much damage was reported from Cabbage Web Worm. A number of truck farmers in South Georgia state that it is impossible to grow cabbage, turnips and other such plants on account of this insect. Remedial measures have not been very successful.

PRESIDENT FORBES: The third paper of the series is "Insects of the Year in Iowa," by Mr. R. L. Webster.

INSECTS OF THE YEAR IN IOWA

By R. L. WEBSTER, *Ames, Iowa*

The following notes on insect injuries in Iowa during the past year are taken from office correspondence of Prof. H. E. Summers and from observations of the writer.

The English grain louse, *Macrosiphum granaria*, which was so common in Iowa and Minnesota last year, has been hardly noticeable during the past season. Early in the spring it looked as if this species might again threaten the wheat and oat crop, as it did last year. Winged forms of *Macrosiphum granaria* appeared in plots of winter wheat at Ames on April 11th. Just where these winged forms came from is unknown. Certainly they did not come from the young nymphs on the wheat, for only the very young progeny of the winged forms themselves were found. Had the species spent the winter on the grain there should have been some pupæ or older nymphs present. Moreover, the plots had been examined almost daily for several weeks preceding and no traces of aphids of any species had been found. The wind had been in the south for two or three days previous, so it is possible that the insect had been blown in. Were the time later in the spring, a migration from one food plant to another would be probable, but at this time of the season I do not know from what plant the aphid would migrate. Last year I found the winged forms of this species at Albert Lea, Minnesota, May 20th, the first appearance of the insect in any form in Minnesota that spring. These winged forms had also apparently only recently reached the grain from some other situation.

The spring grain aphis, or green bug, *Toxoptera graminum*, was also scarce in Iowa this year. Not until July 8th were any specimens found, at which time some apterous forms appeared on volunteer oats. These were found along the right of way of the C. & N. W. Railway, west of Ames. What was probably the same species was found at Council Bluffs on August 6th, but nowhere else in the state. Neither this nor the preceding species were found in southern Iowa in March, when a thorough search was made for them in fields of winter wheat.

The wheat head army worm, *Heliophila albilinea*, was very common over the state during July, especially upon timothy. The stalk borer, *Papaipema nitela*, was also common during the summer, boring in corn and oats. The clover seed caterpillar, *Enarmonia in-*

terstinctana, has been in clover fields in the vicinity of Ames. A rather uncommon plant louse, *Aphis bakeri* Cowen, has been extremely common in clover fields around Ames, causing some serious injury. One field near the college was severely attacked by this aphis. In midsummer the aphids were found on the heads and stems of the plants, but as the weather became colder they moved to the lower parts of the stems, where they were found late in the fall, attended by the large black ant, *Formica fusca*. The aphis was identified for me by Mr. J. J. Davis from specimens found on the stems of clover at Ames.

A strawberry root worm, *Graphops nebulosus* Lec., was reported from the eastern part of the state as causing serious injury to strawberry plants. This is the first time that this species has been noted as being injurious in this stage.

The woolly aphis, *Schizoneura lanigera*, has not been so common in the nurseries of the state as in previous years. It could scarcely be found during the season in nurseries which have had much trouble with this insect. Towards the latter part of July the apple-aphis, *Aphis mali*, became very numerous on apple stock in nurseries, as well as on young apple trees in orchards.

The apple leaf hopper, *Empoasca mali*, continues to be abundant in nurseries generally. In one large nursery at Charles City, in the northern part of the state, the apple stock was again attacked by this little hopper. From some observations made during the summer in various parts of the state, there appears to be five broods of the hoppers during the season, the young hoppers appearing about once a month, from May to September. The lesser apple leaf-folder, *Acleris minuta*, caused serious injury to apple stock in two large nurseries in the southwestern part of the state. A series of spraying experiments showed that this insect may be successfully controlled by spraying with arsenate of lead, the spraying being done when the insect was still in the egg stage. Spraying after the larvæ were old enough to fold entire leaves was of no practical value.

Chionaspis pinifoliae was noticed to be fairly common among evergreens in one of the large nurseries in southwestern Iowa, but did no appreciable damage. Black Hills spruce and Scotch pine were the varieties most affected. A much more serious pest, the San José scale, made its appearance in Iowa during the past year. This outbreak is treated more fully by Professor Summers in a separate article to be given at this meeting.

A cherry slug, presumably *Eriocampoides limacina*, stripped many cherry trees of their leaves in the town of Ames and vicinity. The second brood of this insect was especially numerous. Early in the

season the box elder aphis, *Chaitophorus negundinis,* was very common on the box elder trees in various parts of the state. The Buffalo treehopper, *Ceresa bubalus,* continues to be abundant on young apple trees in orchards, causing serious losses to young apple trees every year. One orchard of fifty acres of young apple trees at West Branch, Iowa, was severely injured by the work of this insect. Clean culture in the orchards is advised against this pest.

PRESIDENT FORBES: These three papers are now open for discussion.

MR. WASHBURN: The paper by Mr. Webster interests me because he deals with insects that we have in Minnesota. We have not been able to find the fall eggs of *Macrosiphum granaria* so far. Last year Mr. Vickery found females producing young under snow, about the tenth of December, and this year we have found the same thing. And in the insectary, where the themometer had been down to five below zero, on the same date, December 10, we found the same condition, but no eggs. We have not been able so far to find any winter eggs. We find eggs of *Toxoptera* and the question arises, is *T. graminum* really a visitor from the south? We find it away up to the northern border, and the fact that the eggs survive the winter and hatch in the spring would seem to indicate that it is with us all the time.

MR. R. L. WEBSTER: I found only the winged forms of *Macrosiphum granaria* early in the year in Iowa and Minnesota. In what form did you find it first this spring?

MR. WASHBURN: I believe they were winged forms.

MR. COOLEY: Mr. President, I have an idea that there will be found an alternation of generations in *Macrosiphum.*

MR. KELLY: I think that Mr. Cooley has undoubtedly found the eggs of *Macrosiphum* at Bozeman, Montana.

MR. SANDERSON: We got the eggs in May or June in Texas, in the laboratory, from two or three different lots, but we never could find any trace of them in the field.

MR. SLINGERLAND: I was interested in the application and mixing of kerosene emulsion. I have a few stunts that I put the boys through in the practical mixing of insecticides, and you would be surprised at the arithmetic they sometimes use in making up kerosene emulsion. I believe it is very important for them to realize the necessity for accuracy in mixing kerosene emulsion.

MR. SHERMAN: If the college student has all that trouble, how

about the actual farmers, nine tenths of whom have never been to college or high school? I make a plea right here for an easy formula that any farmer can understand and use without trouble. All these complications I am inclined to think we can do away with to a large extent, and I do make a plea for simplicity in these things.

MR. J. B. SMITH: I want to express my agreement with what Mr. Sherman has said. It is the basis of my recommendations for commercial insecticides in most cases. Most farmers would pay a little more for a commercial insecticide than to make it up themselves. It was for this reason that I urged, some years ago, upon manufacturers the preparation of an oil that would be directly soluble in water. It was for that reason that I urged manufacturers of chemicals and manufacturing chemists to attempt the preparation of a commercial lime sulfur mixture. It is for that reason that another manufacturer is attempting and has actually manufactured a soluble sulfur, that is, a preparation of sulfur in the liquid form that dissolves by simply putting it in water, without any combination with lime. It is the manufacturer of chemicals that will help the entomologist out if he is given a chance, and I recommend the manufacture of commercial insecticides, and I recommend that the farmer buy his insecticides instead of trying to make them himself, for he will certainly make a botch of it if he possibly can do it.

MR. SLINGERLAND: Mr. President, I feel there is a bit of danger in some of Professor Sherman's notions, especially in regard to the methods of conducting demonstration experiments. I am a firm believer in such experiments, but can we not carry on these demonstration experiments scientifically just as easily? If a farmer sees you do it a bit slovenly, he will often go to the other extreme and do it very carelessly and thus get unsatisfactory results.

A MEMBER: Mr. President, it seems to me that kerosene emulsion has been given a rather bad reputation here in this discussion. I want to come to the rescue of kerosene emulsion as a simple insecticide. It is true that a great many orchard men fail in mixing it up, but I believe there is a chance for the elevation of the standard of our orchard men, so as to make them able to prepare kerosene emulsion and make no mistake. I have seen orchardists in one season, in one county, prepare, of their own accord largely, about 500,000 gallons of kerosene emulsion and use it successfully against woolly aphis, and I want to say that kerosene emulsion against woolly aphis, with its powers of penetration, is a splendid insecticide.

MR. SHERMAN: I maintain that the majority of the people in North

Carolina and every other state will not use these complicated mixtures if they can get anything simpler.

MR. BRITTON: Mr. President, I have been much interested in this matter and about the method of getting information before the farmers who need it. In many cases our bulletins are large and are sent to certain names on the mailing list. They may reach the farmer, but he may be too busy to read them. I wish to call your attention to a simple method which has been used by us for a few years, of getting a very brief notice quickly before the farmers. We call it the "Postal Card Bulletin." It is four by seven inches in size and is made of the same stock as the ordinary postal card. The franks and address can be stamped on the face and on the back is printed very briefly the instructions that we wish to place before the farmer. In receiving this short notice he is more likely to read it and this card is especially well adapted to information of a timely nature. We don't claim any originality for it, though we have not seen anything like it elsewhere.

After transacting the usual routine business, which has already been reported, the meeting adjourned.

A. F. BURGESS, *Secretary.*

The following papers were read by title and are herewith printed in full:

OUTLINE OF AN INVESTIGATION INTO THE USE OF HYDROCYANIC ACID AND CARBON DI-SULFID GASES AS FUMIGANTS

By W. E. HINDS, *Auburn, Ala.*

The second object as stated in the constitution of this Association is "To give opportunity to individual workers of announcing proposed investigations so as to bring out suggestions and prevent unnecessary duplication of work." Although this has long been one of the primary objects in the meetings of the Association, the records show that comparatively little has been presented at the meetings along this line. The writer believes that we may very profitably discuss proposed work in these meetings, and his principal objects in presenting the present paper are three in number. First, to announce the general plan of the investigation which is now under way; second, to give occasion for a general discussion of methods, plans and objects presented, with a view of securing suggestions as to valuable experimental work which has been done by others and as to changes in present plans which may appear advisable; and third, to get an expres-

sion of the views of other workers as to the most important problems existing in this particular field of investigation.

The paper will therefore be confined to a general discussion of the project, leaving out entirely the question of results which have already been obtained. For a general understanding of the project, its subject and objects may be stated as outlined in the writer's plan of work.

Subject.—An investigation of the factors governing the production, diffusion and insecticidal efficiency of hydrocyanic acid gas and carbon di-sulfid vapor as used in economic entomology.

Object.—1. To establish a scientific basis for practical working requirements under known conditions. 2. Determination of minimum effective time and dosage required by various insect species. 3. Determination of maximum safe time and dosage usable with various plants. 4. Standardization of effective and economical formulæ for various needs. 5. Determining modifications required for effective work under varying conditions of temperature, moisture, light, insect protection and plant resistance.

Need for this Investigation.—From many points of view it would seem that this is one of the most important general fields of investigation demanding immediate attention by the economic entomologists. The general requirement for the fumigation of nursery stock before its sale and distribution has led to considerable experimental work in the use of hydrocyanic acid gas. The results obtained are in many instances indefinite, doubtful, or even contradictory, and as a rule the experimental work has been done under such conditions that no reasonable explanation of these inconsistencies can be given. The commercial value of the stock thus treated must amount to many millions of dollars annually. The cost of treatment, while small as compared with the value of the stock itself, is still a large item in the aggregate.

Besides its use for treatment of nursery stock while in a dormant condition, hydrocyanic acid gas is coming to be extensively used for the treatment of citrus trees and green house crops, involving its application to living plants which may be in an active growing condition. The reasons for susceptibility of various plants to injury by gas treatment are but vaguely understood, while their importance as bearing upon the general adoption of fumigation methods in green house and orchard work is very great.

The loss occasioned by insects to stored cereals and their products was estimated by Mr. Marlatt for 1904 as being over 100 million dollars. These losses are particularly severe with corn and various

leguminous seeds. At the present time comparatively little is being done to prevent this enormous loss. If we consider also the damage to such products in retail establishments, to household goods, tobacco products, etc., and consider also that the total crop valuation for 1908 is approximately eight billion dollars as compared with five billions for 1904, it would appear that the total insect damage for which treatment might be made by fumigation will in the three classes of nursery stock, green house crops and storage products probably amount to between 200 and 300 millions of dollars annually.

In spite of the enormous economic importance of these fumigants in insecticidal work, we must admit frankly that our use of them is very largely based upon guess work, which only too frequently results in (1) lack of insecticidal efficiency, (2) more or less injury to the plants or materials treated, (3) to unnecessary expense involved in the waste of materials and frequently also in the time given to the treatment. In case the treatment given is too weak to kill the insects for which it is applied, all of the materials and time must be considered as wasted, and similarly there is a waste in the use of a large excess above what is actually needed to kill the pests.

Even with hydrocyanic acid gas, which has been used experimentally much more than has Carbon di-sulfid, it is evident that there is a great variation in the dosage advised by different entomologists for the same purpose. No reasons for such variations are given, and only too frequently the results obtained are such as to discredit the reliability of entomological recommendations.

Particularly in regard to the use of Carbon di-sulfid it is noticeable that the great majority of recommendations are mere repetitions of what some other man has previously advised. So far as we have been able to learn, very few definite investigational experiments have been attempted with this fumigant, and unquestionably the recommendation which is generally given cannot be relied upon to accomplish the desired result.

It seems therefore that the field open to investigation is exceedingly broad and sufficiently important to command the most careful investigation possible.

Scope of Work Contemplated.—In a general way we propose to cover a fair range of subjects in the field outlined above. To learn for each fumigant under different working conditions the general limits of minimum dosage necessary to effect the destruction of various insect pests, the maximum treatment endurable by various living plants, both in green houses and out of doors; and for nursery stock, to determine the modifying influences of such obvious factors as light,

temperature, humidity, etc., and to test other factors which may seem important. The treatment of seeds intended for germination is another important phase of the work, both as regards the prevention of insect injury to the seed and the possibility of preventing this without injuring, by the treatment, the germinating power.

It will be seen from the preceding statements that the work contemplated involves more than the usual field of economic entomology, particularly in the determination of the maximum endurable time and dosage usable with various plants and in the modifications required for effective work under varying conditions of temperature, moisture, light, etc. The project involves much work in anatomical and physiological botany.

Co-operation.—Arrangements have already been made for coöperation in this botanical part of the investigation. Prof. F. E. Lloyd, whose investigations regarding the "Physiology of Stomata" have been recently published in Carnegie Institution Bulletin No. 82, has been recently appointed professor of botany and botanist to the Experiment Station of the Alabama Polytechnic Institute. His experience in this field of investigation seems to fit him in an exceptional way for this portion of the work. He will therefore undertake, in cooperation with the Department of Entomology, the investigation of the anatomical and physiological reactions of various plant tissues to these two fumigants, especially with regard to the effects upon their nutritive and respiratory functions. He will also investigate the general question of the susceptibility or resistance of common green house and other plants frequently liable to such treatment, to the effects of these gases under various conditions of treatment so as to determine, if possible, the general conditions under which fumigation for insect pests may be practised with the greatest possible safety to living plants. The ultimate object will be to establish a basis for making intelligently such necessary or desirable modifications as are demanded for successful fumigation work under varying practical conditions, so that the destruction of insect pests may be assured without endangering the life of the plant and without involving needless expense in time and materials for making the treatment.

Methods of Procedure.—The following general principles will be observed whenever possible in securing the data upon which the conclusions may be based:

1. Chemical analysis of samples of materials used in tests.
2. Establishing definitely known working conditions.
3. Securing data from experiments in which, so far as may be possible, only one factor at a time will be varied.

4. Selection of subjects to secure uniformity and to render results comparable.

5. Determination and study of the influence of important modifying factors.

6. Immediate classification of the data.

7. Statements of general results and conclusions indicated by work done and determination of their bearing upon the establishment of general principles for practical work.

In a general way the method of procedure adopted is to secure preliminary indications of results by conducting series of small tests under controllable laboratory conditions. E. g., for this work two-liter bell jars are used and the work with insects and seeds begins under the constant condition of a practically uniform strength of gas acting through a graduated series of time intervals. In this way one factor at a time will be varied until ultimately the usual, general effect of each may be established.

When these small tests have indicated some general result, tests will be made using fairly large quantities of material to determine the constancy of the results obtained. The general applicability of methods of treatment to usual conditions under which treatment may be required will then be investigated. Thus laboratory results will be checked by practical application under the conditions for which treatment might be advised.

In conclusion I may say for those conducting this investigation that we shall cordially welcome at all times criticisms showing any avoidable points of weakness in our work. We shall be glad of any suggestions as to improved methods for securing the information we need and we are especially desirous of securing the benefit of the viewpoint of others regarding the importance of various problems which may properly come within the scope of this investigation.

ENTOMOLOGICAL NOTES FOR MISSOURI FOR THE SEASON OF 1908

By Mary E. Murtfeldt, *Kirkwood, Mo.*

Throughout Central Missouri and in many other sections of the Mississippi Valley somewhat unusual weather conditions have prevailed for the past two years and it has been interesting to note the effect upon the disappearance or prevalence of injurious insects.

In 1907, from the 15th to the end of March, July heats and showers

were followed by very low temperatures and sleet and snow storms over a large part of the Middle West. In consequence of this, almost the entire tree fruit crop was destroyed. Here and there in peculiar situations a few peaches and apples matured, but in the vicinity of St. Louis there was such a dearth of the larger fruits that very few codling moth or curculio larvæ were able to find sustenance, and orchardists were to some extent comforted for the loss of their crops by the assurance that not enough of the principal pests of the more important fruits could possibly survive to do appreciable injury the following year.

But nature has many resources for man's discomfiture. True, codling moth larvæ and curculios, as predicted, were scarcely to be seen, and the winter had been favorable for the preservation of the fruit buds, but scarcely had the blossoms begun to unfold when an overwhelming outbreak of *Aphididæ* occurred. *Aphis mali* on apple and quince, *A. prunifolii* on the plum, *Myzus persicæ* on the peach, in such numbers that the blossoms were dwarfed and tarnished and the young leaves so distorted and crumpled that the trees had the appearance of being blighted. Comparatively little fruit set, even on trees that were sprayed, and very few or no perfect fruits developed on apple, pear or quince trees. The scanty crop of peaches—reduced chiefly through the extensive injury to the foliage—was of better quality than that of the pip fruits, and this was also the case with such of the cherries and plums as escaped the brown-rot.

In the vegetable garden also, the same class of insects rendered young plants of cabbage, mustard, lettuce, and later melons and cucumbers, objects of abhorrence with the piled-up myriads of sap suckers clustered on leaf and stem and blossom. In the flower garden scarce a shrub, herbaceous, perennial or annual, afforded any satisfactory blossoming or luxuriant growth throughout the season on account of the extraction of its vital juices by aphids, green and yellow, brown and red.

This would not have been the case had not almost constant and torrential rains prevailed throughout May and June, undoubtedly drowning out the natural enemies and checks of these pests. It was not until the middle of July or later that I began to note on the clusters of aphids some Coccinellid, Syrphus and Chrysopa larvæ and during the succeeding late summer and autumn drought these multiplied and proportionately aphids diminished. *Aphidius* and *Aphelinus* species did not become at all numerous, to judge by the comparatively few parasited specimens observed.

At present (December 20) very few aphid or winter eggs are to

be found even on the most profusely infested trees and plants, and fruit growers and gardeners are hoping that the scourge has run its course for the present.

[This concludes the list of papers read by title.]

NOTES ON INSECTS AFFECTING THE COCOANUT TREES IN THE SOCIETY ISLANDS

By R. W. Doane, *Stanford University, Cal.*

In a previous issue of this Journal, 1: 341, I have given a few notes on *Aspidiotus destructor* and its work on the cocoanut trees in these islands. While this insect is responsible for the greatest injury to the trees, there are several others that are of more or less importance. Among the scale insects *Hemichionaspis aspidistræ* ranks next to *A. destructor* in numbers and probably in amount of damage done. The two are usually found together on the leaves and fruits. *H. aspidistrae* occurs on all parts (except the trunk and roots) of both the old and young trees, the white scales of the males often forming white patches that nearly or quite cover the leaflets on many of the leaves. But it is on the nuts that it is most abundant and most conspicuous. The husk of both the young and the old nuts are often almost completely covered with it. On account of this habit of attacking the husks of the nuts it is not as injurious as it would be if it confined its attention to the young tender leaves. I also collected it and had it sent to me from several of the islands of the group on a number of unidentified weeds and shrubs. Everywhere it is abundantly parasitized by a small chalcid, but I did not succeed in rearing the parasite. *Lepidosaphes gloveri* is often very abundant on the bases of the older leaves, but as long as its attacks are restricted to this part of the tree the damage done is not very great. It is everywhere badly parasitized. On some leaves practically all of the scales showed the small round hole where the parasite had escaped. On the young tender unfolding leaves of many of the trees, both old and young, are to be found large colonies of *Pseudococcus pandani*. Some of the young trees are seriously injured in this way, for as fast as the tender leaves break from their sheath the insects attack them and when abundant produce a considerable amount of honey dew. This mixed with the white flocculent excretion collects in large drops and masses in the folds of the leaves around and below the colony. No

natural enemies of these insects were observed, but the fact that they are only to be found on protected parts of the tree would indicate that some predaceous form keeps them from spreading to more exposed parts. It is possible that the small skinks and geckos that are so abundant on many of the trees snap up any of the insects that are accessible. What seems to be the same species of mealy-bug occurs abundantly on the *Pandanus*. These are often in somewhat more exposed places and I have seen the larvæ of lacewing flies feeding on them. It is very likely that these larvæ attack the mealy-bug on the coacoanut trees as well. This is probably the same species of *Pseudococcus* that is reported as doing considerable damage to cocoanut trees in other groups of the South Sea Islands.

Toward the base of many of the older leaves on some of the trees may be seen small holes, from which flows a resin-like exudation. Often this has issued to such an extent that the whole lower portion of the leaf is covered, or it collects in lumps on the leaf below. Often bits of leaf-fiber and larval castings are mixed with the exudation. Around these holes the tissue of the leaf is more or less blackened and decayed. Two different types of these holes may be found, usually on the same tree, distinguishable principally by their size and the amount and extent of the injury. Both are made by the larvæ of weevils; a large one, the adult of which is about 13 mm. in length, and a smaller one about one half the size, kindly identified by Mr. Schwarz, through Doctor Howard, as *Sphenophorus obscurus* Boisd. and *Calandra taitensis* Guérin. The larger larva usually works closer to the base of the leaf, often killing the leaf by burrowing all through it. Sometimes the larva will keep close to the edge of the leaf or go only as far in as the center, boring a tortuous chamber from ½ to ¾ an inch in diameter. The burrow is usually filled with the chaff and castings and the larva is usually found at the upper end of the burrow. Often from the blackened portion of the infested leaf the resinous exudation will be issuing in several places, making it appear that several larvæ are at work in the same leaf. This is sometimes the case, but a single larva may bore along a leaf stem for 12 to 15 inches, causing the exudation to flow in abundance from several openings and making many large discolored spots, beneath which the tissue is soft and decayed. The older leaves are usually attacked. After attaining its full growth the larva bores close to the surface and constructs a rude oval cocoon out of the fiber that it has been eating and transforms to the pupa stage, from which it later issues as the adult beetle. These cocoons may usually be found quite abundantly in the chaff at the base of old leaves or in the old leaves. In some in-

stances the larva bores into the trunk of the tree for a short distance where the broad leaf-base joins the tree. In one instance I found the beetle quite abundant in and around the growing tip of a young tree that was dying, whether as a result of the work of the beetle or from some other cause I was unable to determine.

The smaller weevil, *C. taitensis,* seems to be much more abundant and on account of its habits is perhaps more injurious than the larger species. It is found most commonly boring into the edge of the base of the leaf-stem. Its presence is indicated, as with the larger species, by the presence of a gummy exudation mixed with castings. These are often in the shape of long twisted strings, ¼ to ½ inch long. As the larvæ do not work as deep in the tissue of the leaf as do those of the larger species, the damage here is not very great, but when they work further out at the base of the leaflets many of the leaflets are destroyed.

A still more serious damage is done where the larvæ attack the spikelets, killing them at the point of attack and working toward the base. As long as they confine their work to the portion of the spike having only the male flowers the damage is not serious, because the number of these flowers is so great. But when they attack the spikelet below the female or fruiting flower, the young fruit is killed. After the larva has become full grown it makes for itself a rather long cell, with a very thin wall on one side, and, without making a cocoon, changes to the pupa, from which, later, the adult emerges and breaks through the thin wall of its cell.

Another insect that is doing much damage to many of the cocoanut trees on all parts of these islands is the larva of a small moth that works on the underside of the leaflets, eating away the lower surface and causing the whole leaflet to turn brown and die. Often a large portion of the leaf is thus destroyed, giving the whole tree a very ragged appearance and of course doing considerable damage when many leaves are affected. The larva spins a thin, protective net of silk as it feeds. Along the midrib or at the base of the leaflet a denser web is formed, to which the larva, by a peculiar jerky motion, retreats when disturbed. A very few pupæ were taken, but I was not able to rear the adult moth, so I cannot identify the species.

There is another small moth larva that may prove to be of considerable importance on account of its habit of attacking the male flower buds as soon as they are exposed by the opening of the spathe. Many of the spikelets are nearly or quite stripped of their buds before the flower opens. The larva works just at the base of the bud, usually inside, often extending its work out along the stem for a short dis-

tance, and sometimes boring into the spikelet. In some instances the web may connect two or three near-by buds, the larva resting between or in one of them. The larvæ when disturbed or driven from their retreat move along the spikelet with a quick, jerky motion. No adults were reared, so I do not know the species.

On some of the trees, where male spikelets were in bloom, the spike would be literally covered with two species of Oedemerids, *Ananca livida* Fab. (Oliv.), and *A. collaris* Sharp (also identified by Mr. Schwarz), the former being more abundant. They were feeding on the pollen and where a spike was badly attacked practically all the pollen was destroyed. This might prove to be of some importance if many trees were attacked. Mr. Schwarz points out that the members of the closely related American genus *Oxacis* breed in rotten wood and that the imagoes of some of the Florida species congregate on the flowers of palm trees. A thorough study of the insect enemies of the cocoanut trees in this region would doubtless result in a considerable saving to the planters.

RECENT WORK IN INSECT BEHAVIOR AND ITS ECONOMIC SIGNIFICANCE[1]

By WILLIAM B. HERMS, *Assistant Professor in Entomology, University of California*

Animal behavior has been the subject of much investigation during the past ten years, with the purpose of analyzing the organism's method of orientation to a stimulus and the method of locomction toward or away from such a source of stimulation. Paper after paper has been published, affording considerable information on the subject,—the "tropism" scheme, the "trial and error" method, and the "random movement" method have been advanced and criticised, internal factors and external factors have been considered, sundry methods of experimentation have been applied,—but little has been done with an economic aim. Certainly a narrow viewpoint would be evident were we to expect an immediate economic return for every new effort in science; it must be considered that many if not all applied sciences have found their origin in pure science, and a heedless attitude toward the same may result in actual hindrance to progress. But the agriculturist who has to deal at first hand with the pests of the orchards and of the field may well ask the question of the student of animal

[1]A paper presented at the Watsonville (California) Entomological Conference, Aug. 25, 1908.

behavior, "Can your science lend us aid in the warfare against our enemies?" None present this afternoon will doubt for an instant the commercial importance of such biological sciences as zoölogy, entomology and botany, even at this time when the economic department of these subjects is still in its infancy, and it is safe to say that the next few years will prove the same for the science under consideration.

It is my purpose in this paper to first point out the scope of "Animal Behavior" as accepted by the more progressive group of workers in this field led by such investigators as Parker, Jennings *et al* on the one hand, and Yerkes, Watson *et al* on the other. As just indicated, it should be understood that there are really two more or less distinct groups of workers in the science of animal behavior: the one concerned mainly with the external factors—the comparative physiologists; and the other group concerned mainly with the internal factors—the comparative psychologists.

In the second place I wish to point out some of the more recent work in *insect* behavior, treating this phase from a more or less critical standpoint.

1 Scope of Animal Behavior

The behavior of anything, whether organic or inorganic, rests upon activity; the activity of *living* things is determined by the interaction of two classes of determining factors viz.:

1. Quality of the protoplasm=internal.
2. Quality of the environment=external.

By any change of the external agencies that act upon the organism, the latter is stimulated, because irritability is a characteristic of protoplasm. Therefore a *stimulus* may be defined as any change of the external agencies which act upon the organism, *e. g.*, alteration of temperature, moisture, amount of food, etc.,—in short, the addition of a new factor, or the increase or decrease in degree of an old factor. *Stimulation* is the result of contact of a stimulus upon the living substance, and the fact of stimulation is made obvious by movement or by a reaction of some kind. Stimuli may vary enormously in extent as thermal and chemical stimuli, but the limits within which these conditions act as a stimulus are very narrow, and the total range of a stimulus has not equal importance. The animal lives better near normal conditions than near either extreme. Every organism is adapted so that it will live best at a certain degree of stimulation, *i. e.*, optimal—at the minimal or maximal death ensues.

The reaction of an animal is carried out through the inter-relation

between the sense organs (receptors), the central nervous system and the muscles or glands (effectors). Among the most intangible phenomena that we have to deal with are sensations, yet the old classification of sense organs is based on such internal conditions, and consequently the usual classification, that of sight, smell, touch, hearing and taste is quite unsatisfactory. Because of the inadequacy of the subjective basis for classification, the tendency is to transfer the treatment to an objective basis.[1] The external world forms a basis for the source of stimuli or energy change. On this basis sense organs are grouped into only two general classes, viz.: 1. Sense organs stimulated by ether changes, such as light, heat and electricity. 2. Sense organs stimulated by material changes, sub-divided into two subclasses: *(a)* Physical, organs which receive prolonged contact stimulation, such as touch and pressure, and organs which receive vibratory contact, commonly called sound organs (hearing); *(b)* Chemical, organs which serve as receptors of chemical stimuli, taste and smell.

Thus the weight is thrown on the external world, we are not limited to sensations, and, what is most important, a basis for measurement may be secured,—*e. g.*, light intensity can be measured in terms of candle meters and can be controlled; chemical solutions can be measured in degrees of concentration and can be controlled. And here is where the great difference exists between earlier and more recent work in animal behavior. Accuracy of measurement is the great criterion by which modern work is judged, and this involves not only a knowledge of zoölogy or entomology and their histological methods, but also a knowledge of the physics and chemistry of the stimulus employed. The following extract taken from the editorial notes of a recent number of the Experiment Station Record[2] is quite apropos at this time:

"The advantage of agricultural science over the individual sciences as applied to agricultural problems should lie in its special point of view and in the bringing of various sciences to bear on these problems. For its purposes the boundaries of the primary sciences are overstepped. The investigator in that field is not restricted to a single science, but employs the teachings and the methods of several, as his case requires, acting as a connecting or coördinating agent. This cosmopolitan relationship calls for widespread familiarity with the whole field of natural science. Its danger is too close specialization and disregard of everything in the pure sciences which does not bear directly and quite immediately on the field of agriculture. Such a course tends to narrowness and to superficiality on the part of its adherents."

2 Recent Work in Insect Behavior

As numerous as this group of animals is, comparatively little has been done on them by workers classed as students of animal behavior, and furthermore that which has been accomplished has been directed largely toward species of relatively little economic importance. The pomace fly (*Drosophila ampelophila*) has received much attention in the Harvard zoölogical laboratories, chiefly because of its availability during the winter months, since it is easily reared in artificially heated rooms. Carpenter[3] has made a study of the reactions of this fly to light, gravity and mechanical stimulation. The fly moves toward a source of light, *i. e.*, light has a directive effect, but this is not apparent until a sufficiently powerful kinetic stimulus (light or mechanical) has been exerted to induce locomotion. When very high intensities are used, *e. g.*, a 250 c. p. arc light, at 40 cm., the directive effect of the light is apparently inhibited. Continued exposure to direct sunlight caused many insects to come to rest in the least brightly illuminated regions and with the heads away from the source of light. This last fact is explained because this is the position in which the least light enters the eyes, and in which, as a consequence, the kinetic stimulus is least. The great number of these flies around cider presses, orchards and packing houses where fermenting fruit is often found in quantities, leads one to wonder how these creatures find these localities. It is, of course, a well known fact that these flies deposit their eggs in fermenting fruit, and that the larvæ or maggots feed and develop in such matter. The most natural inference (because these insects bear conspicuous compound eyes) is that the food is located by means of the sense of sight, but as a matter of fact "they find their food with great certainty even in the dark." This led Barrows[4] to take up an investigation of their reactions to "odorous substances." The flies were tested by accurate methods to various intensities of substances commonly found in fermenting fruit, such as ethyl alcohol, acetic and lactic acid, and acetic ether, each used separately and also mixtures of them. The intensity of concentration was known in each, an important consideration in such work. It was found that the optimum strength of ethyl alcohol and acetic acid is 20 and 5 per cent respectively. It was further ascertained that cider vinegar, fermented cider and California sherry contain alcohol and acetic acid in percents very close to the optimum strength. By experiment it was next determined that the sense of smell by means of which food is found, is located in the terminal segment of the fly's antenna.

The eyes of insects have long been studied for their structure and physiology and one of the most important studies recently made on the image-forming powers of eyes was carried on by Cole.[5] This investigator experimented on *Vanessa antiopa* (the mourning cloak butterfly), *Ranatra* (the water scorpion), *Tenebrio* (the meal worm), and again the pomace fly, also several other animals. This work, though not conclusive for some of the species studied, provides conclusive evidence that at least the mourning cloak butterfly and the water scorpion of the animals possessing compound eyes have image-forming powers. This evidence is further augmented by recent experiments by the writer[6] on two common species of flesh-flies, *Lucilia cæsar*, and *Calliphora vomitoria*, with the further evidence that the eyes of these flies have this power not so well developed as the butterfly, which is probably correlated with differences in habit, the flesh-flies being more dependent on their sense of smell. Parker[7] in his investigation of the light reactions of the mourning cloak butterfly, discovered that it reacts to bright patches of sunlight. The larvæ of *Corethra plumicornis*, a short-beaked mosquito, have received the attention of various investigators, among them Harper,[8] who has investigated experimentally their daily depth migration. Ants have formed the basis of a number of classical works represented by Lubbock, Forel and Wasmann, and still these interesting creatures receive the attention of many recent investigators with results fully as significant, due to the application of new and more accurate experimental methods. Much of this work has however taken the form of comparative psychology, as has the splendid work of Turner.[9] The investigations of Fielde,[10] and Fielde and Parker,[11] have afforded us much information on the sensory reactions of these organisms.

The above references have been made to afford some idea of the nature of the work carried on by students of animal behavior, and it will be seen that that which concerns the economic worker most is the experimental method applied, since the species studied have little or no significance from the economic standpoint. But it is this experimental method, carrying with it utmost accuracy, that may well concern us who are interested in the control of insect pests. What is most needed at this time in the study of economic species,—granting the importance of a knowledge of life histories,—is a knowledge of its reaction to a given stimulus (the optimum stimulus) not only at one period of its life history but throughout every active period, because the reaction of an animal at one stage may not be its reaction at another, *e. g.*, the flesh-fly, *Lucilia cæsar*. Though others supposed its reactions to light to be of a rather simple nature, which is

largely true for a given period, its reactions throughout the life history of the individual show progressive change, viz.: first, during the feeding period the larvæ as a body react positively to artificial light, though as individuals they are apparently always strongly negative; secondly, the migrated larvæ (in the pre-pupal period) are uniformly negative; and finally, though the larvæ pupate as negative organisms, they emerge in a positive state. (In this connection one should consider the fact that the larvæ are eyeless creatures, while the adults possess well developed compound eyes.) The following table shows this range of reaction of *individuals* to a given stimulus, light of 0.56 C. M. intensity.

TABLE 1

Summary of reactions of Lucilia cæsar (Lot No. 10) at different ages to directive light (0.56 C. M.). Based on ten larvæ given five trials each to an exposure of thirty seconds.

DATE—1907.	AGE.	STAGE.	REACTION TRIALS.			REACTION PERCENTAGE.		
Dec. 5, a. m.	Birth.	Just hatched.	a 8	5	7	a 40	25	35
			b 1	11	8	b 5	55	40
" 6, 10:45 a. m.	24 hours,	Feeding.	6	31	13	12	62	26
" 7, 10:35 "	48 "	"	3	36	11	6	72	22
" 8, 10:35 "	72 "	"	1	42	7	2	84	14
" 9, 10:45 "	96 "	"	0	44	6	0	88	12
" 10, 10:35 "	110 "	"	0	47	3	0	94	6
" 11, 10:35 "	6 days.	Prepupal.	1	47	2	2	94	4
" 12, 10:40 "	7 "	"	2	48	0	4	96	0
" 13, 10:35 "	8 "	"	0	50	0	0	100	0
" 14, 10:30 "	9 "	"	3	46	1	6	92	2
" 16, 10:30 "	11 "	"	2	28	0	7	93	0
" 17, 10:30 "	12 "	"	0	20	0	0	100	0
" 18, 10:30 "	13 "	"	0	10	0	0	100	0
" 26-30.	25 "	Imago.	27[1]	1	0	97	3	0

A further question which must be carefully considered is, Does the behavior of the organism vary with the intensity of the stimulus and what is the variation? This is again illustrated by another table (Table 2), which shows the reactiveness to directive light for various intensities of two species of flesh flies. Here is also illustrated the difference in reactiveness of two related species to exactly the same

[1] This aberrant reaction was on the part of an individual whose wings did not spread and was consequently forced to creep. All other adults first perched on the edge of the vial in which they were retained and then flew toward the light.

intensity of stimulation, *i. e.*, an examination of the following table reveals the fact that *Lucilia cæsar* is a fly which is more reactive to light in the larval stage than is *Calliphora vomitoria*, which was also experimentally shown for the adults.

TABLE 2

Reactiveness to directive light through the general range of intensity for migrated larvæ of Lucilia cæsar (Lots No. 6 (A) and No. 25 B), and of Calliphora vomitoria, (Lot No. 24.)[1]

Source of Light.	Intensity in C. M.	REACTIONS *L. cæsar.* P. N. I.			*C. vomitoria.* P. N. I.		
Diffuse daylight.	?	(A) 0	50	0	0	50	0
Arc light.	800.	(A) 0	50	0	0	47	3
Incandescent light.	0.56	(A) 1	44	5	3	44	3
" "	0.1764	(A) 5	37	8	8	32	10
" "	0.0342	(A) 6	35	8	2	35	13
" "	0.00705	(B) 0	33	18	7	24	19
" "	0.00176	(B) 2	28	20	8	17	25
" "	0.00063	(B) 5	14	28	9	11	30
" "	0.00007	(A) 1	3	46	5	4	41
.....	Total darkness.	(A) 2	2	46	5	1	44

It should be explained that the study of the flesh-flies was undertaken by the writer [12] because of their importance as scavengers of lake beach debris, and were used later as favorable organisms for detailed observation with regard to light reactions.[6]

In conclusion I cannot refrain from expressing my regret that there are students of animal behavior who know only the laboratory aspect of animals, who seem to believe that it is unbecoming to carry on field observations. Plucking an animal from its native soil without a thought of its natural environment and hustling it into the laboratory and subjecting it there to all manner of stimuli, often of unknown intensity and quality, is certainly not a commendable method of procedure. The normal environment and normal behavior of an organism should have the experimentor's closest attention, in order to aid in a correct interpretation of the phenomena observed under experimental conditions. A combination of field and laboratory

[1] The reactions (P. N. I. = positive, negative and indifferent respectively) are based on the movements of ten larvæ given five trials each at an exposure of thirty seconds. Between trials, taking larvæ No. 1 first, then No. 2, etc., through the series, each individual was kept separate in a closed receptacle.

observation affords in the writer's estimation the most satisfactory basis for experimental work. Having determined the physiological differentiation of the organism, a histological test for structural differentiation of sense organs can well be undertaken, and with these two factors well in hand we have a splendid basis for practical control.

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QUACK GRASS (AGROPYRON), A HOST OF THE HESSIAN FLY[1]

By PAUL HAYHURST

As far as we know it has not yet been definitely proved that the Hessian fly can breed on any grass besides its three well-known hosts, wheat, rye and barley, although many attempts have been made to shed light on this question. It was, therefore, with unusual interest that puparia, apparently of this species, were accidentally discovered in quack, or couch-grass, *Agropyron repens,* at Forest Hills, Mass., Nov. 8, 1908. They were particularly numerous on a small piece of cultivated land where this grass had sprung up in early autumn. It must, therefore, have been especially suitable for oviposition when the fall brood of adults were flying. Puparia were found at several other points in this neighborhood, but never in the larger, tougher plants. They were all embedded in the stems just above the roots like the true Hessian fly, and the injured plants showed precisely the same effect. There was no stubble or volunteer grain near the infested grass, and the nearest field of grain was a little rye about a mile east, which was, therefore, not in the direction of the prevailing winds. The U. S. Weather Bureau states that these were S. W. during September, 1908. It seems improbable that this attack on the quack was accidental from neighboring grain fields.

We thought it best to rear the adults and to test their specific identity by breeding them on wheat. Acordingly 65 specimens were collected from the quack and placed in a vivarium. On Dec. 10th adult males and females began to emerge. A number of these were enclosed over young growing wheat. Eggs were laid freely in the furrows of the dorsal surface of the leaves in the usual way of the true Hessian fly. The reddish larvæ hatching from these eggs stationed themselves in the stems just above the roots, and adults of both sexes emerged the following February. Specimens of these flies together with their parents reared from quack were sent to Doctor Felt, an eminent authority on the Cecidomyiidæ. He kindly replied as follows: "I have studied the material . . . and I see no reason for not regarding the Mayetiolas reared from *Agropyron repens* taken in the field, and the descendants therefrom bred on wheat in the insectary, as other than the Hessian fly, *Mayetiola destructor* Say."

Doctor J. Portschinsky, Chief of the Bureau of Entomology of the

[1]Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 4.

Ministry of Agriculture of Russia, St. Petersburg, wrote to us as follows relative to this species on quack in his country: "Several Russian naturalists (Portschinsky, Jaroschewsky, Philippiew, Lindemann) have several times found the larvæ of this species in numbers on the stems of *Agropyron repens*. We consider this plant as natal for this insect."

Prof. F. M. Webster wrote to the author in these words: "With regard to your breeding Hessian fly (*Mayetiola destructor*) from quack grass, I will say that it seemed to breed freely in *Agropyron* in Kansas last year, very evidently originating from serious outbreaks of the pest in adjacent fields of wheat. In order to make sure, the species will need to be bred from *Agropyron* to wheat and those from wheat bred from *Agropyron*. When this has been done, all obscurity, it seems to me, relative to the occurrence of Hessian fly in grasses will be swept away."

We believe that the determination of specimens taken in native grasses has never before been corroborated by biological criteria. We can now say with certainty that the true Hessian fly can breed freely in quack at least under some conditions. It is therefore important to know more about these conditions. Evidently they will breed most readily in grass that is young and tender in the fall at the time of oviposition. Since quack is a noxious weed almost everywhere in the United States, it is unfortunate to have to regard it as even a possible source of infestation. It is not likely, however, that the fly is usually plentiful enough in quack to make it a dangerous source of trouble from a practical point of view, except possibly in rare instances. If it were generally so numerous in this grass, one would expect it to be well known at this late date.

The question can now be raised whether quack was the original host of the Hessian fly which was able to develop more abundantly on the cereals after their introduction by man. If this should be so, then the history of this insect would be a parallel case to that of the Colorado potato beetle. If *Agropyron* could be found infested with Hessian fly in regions remote from cereal crops, we would consider it the original host. In this case the insect might have been native anywhere in the temperate regions where the circumpolar *Agropyron* grows. There would then be no mystery about its introduction in America. But this must be considered a profitless subject for speculation, unless the nativity of the insect on quack should be tested as above suggested.

The following is a brief summary of the observations by others on the supposed Hessian fly in native grasses:

In 1887 Koebele found puparia in *Elymus americanus, Agrostis* sp. *Bromus ciliatus* and *Agropyron* sp. in California. Flies reared from these were sent to Washington where they were considered the true Hessian fly. The determination of the *Elymus* material was later disputed by Mr. Theo. Pergande, of the Bureau of Entomology, on some small structural differences between the specimens and some others reared from wheat.

In 1888 Lindemann reported considerable infestation in timothy and quack in the Russian governments of Tambaw and Woronesh; but he does not say that he reared the adults.

In 1897 Marchal repeated Forbes' experiments, likewise with negative results, on these grasses: *Bromus pratensis, B. mollis, Dactylis glomerata, Festuca pratensis, Alopecurus pratensis* and *Holcus lanatus.* He demonstrated clearly by biological experiments that *Mayietiola avenæ* (Marchal) infesting oats in France was specifically distinct from *M. destructor* (Say). He called attention to eight other species belonging to allied genera that attack native grasses. He thus showed the necessity of verifying the determination of supposed Hessian fly puparia in indigenous grasses by the "criterium biologique," and he asserted that evidence of this character was still lacking in all the work done on this insect.

In 1898 Osborn adopted Marchal's position as final and pointed out that over the immense wheat-growing sections of the United States no record exists of an infestation in native grasses.

In 1906 Gossard and Houser found a few eggs laid voluntarily on the following grasses near wheat fields in Ohio: *Festuca pratensis, Arrenatherum avenaceum, Poa pratensis, Lolium perenne, Dactylis glomerata, Bromus inermis.* Very few eggs were laid on each grass, and none developed except on one plant supposed to be a *Lolium,* but never satisfactorily determined. Flies were induced to oviposit in vivaria on fox-tail, orchard grass, timothy, redtop, blue grass and wild rye (*Elymus canadensis*) but none of the larvæ developed.

It will thus be seen that the Hessian fly positively determined from the adults has been secured from quack in California, Kansas and at Forest Hills, Mass. It seems, curiously enough, that *Agropyron* (*Triticum*) *repens* has never been used in breeding experiments, although it is closely related to wheat (*Triticum vulgare*) and is everywhere available.

The writer takes pleasure in acknowledging Professor Wheeler's kind suggestions relating to these observations.

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WESTERN SPREAD OF THE COLORADO POTATO BEETLE

(*Leptinotarsa decemlineata*)

By J. M. Aldrich, *Moscow, Idaho*

Economic entomology has preserved in its archives pretty full details of the eastward advance of this insect. Starting from the arid region along the east side of the Rocky Mountains in the late fifties, when the introduction of the potato first enabled it to "switch" from its wild food-plant, *Solanum rostratum*, it was about fifteen years in reaching the Atlantic seacoast of the United States, and in a few years more it was omnipresent in the eastern two thirds of the country.

It is a striking fact that the advance of settlement and potato-raising west of the continental divide did not carry the beetle with it. Professor Gillette writes me lately that even yet he has looked for the insect in vain west of the main divide in Colorado. As far as I have ascertained in considerable travel through the West, there are no potato beetles on the western side of the Rockies except as noted herein.

Professor Cooley of the Montana Experiment Station writes me that it has in quite recent years established itself in the Bitter Root Valley of western Montana, although as yet it has not reached the upper end of the valley. He also finds it in Flathead County. Both of these localities are on the western side of the continental divide.

A new western record for the insect is the town of Nez Perce, Idaho, about forty miles southeast of Lewiston. It has been established in that neighborhood at least two years, and seems to have spread considerably last summer. I do not know of it elsewhere in Idaho.

Considering the numberless opportunities for the carriage of adults westward on railroads, it seems probable that the species has generally died out when introduced, before it became fairly established. I am informed on very good authority that a potato patch in Moscow, Idaho, was infested about sixteen years ago, but the insect did not reappear the following season. Our wet winters may account for its inability to maintain itself here, but that certainly will not hold good in all the territory concerned.

It would be interesting to learn what others have observed in the West, both in regard to the spread of the insect and to the agencies which appear to retard its advance.

A MOTH LARVA PREDATORY UPON THE EGGS OF THE BAGWORM[1]

By A. B. Gahan

In the course of some rearing experiments of the parasites of the common bagworm, *Thyridopteryx ephemeræformis*, during the past fall and winter, the writer was surprised on numerous occasions to find in the cages specimens of a small pyralid moth. The repeated occurrence of this handsome little lepidopteron led to an investigation to ascertain the reason for its presence. The result was the interesting discovery that the moths, which were identified by Dr. H. G. Dyar as *Dicymolomia julianis* Walk., were feeding in the larval stage upon the eggs of the bagworm. Numerous bags collected in February from cedar and black locust were cut open and in a large percentage of them larvæ in varying stages of development were found buried among the eggs in the old pupal skins of the females. In one instance two larvæ were found in the same bag. In every case where a full grown larva was found, the eggs of the bagworm had been completely destroyed. A larva was placed in a small vial with some of the eggs and later observed to seize an egg in its mandibles and devour its contents. When full-grown the larva crawls out of the egg case, and proceeds to spin a small cocoon at the tip or free end of the bag within which it changes to a pupa five-sixteenths of an inch in length and of a clear pale red color. The imago after escaping from the pupal skin forces its way out of the bag at the lower end. Its normal time of issuance can at present be only conjectured, as specimens were obtained in the laboratory in each of the months of January, February, March and April. Under outdoor conditions, they would probably have appeared in late April or early May.

That this predatory moth constitutes a considerable check on the bagworm in this locality cannot be doubted when it is known that in some cases 25 to 30 per cent of the female bags were infested; and that its presence in the bags was not a purely accidental or local occurrence, but is a more or less well developed habit if not characteristic is proven by the fact that Prof. A. L. Quaintance reared it from the same source in Washington, D. C., coincidentally with the writer (as was brought out in a discussion before the Entomological Society of Washington in March, 1909).

Dr. Dyar informed us that the normal habit of the species as here-

[1]Contribution from the Entomological Laboratory of the Maryland Agricultural Experiment Station.

tofore understood was to live as a scavenger in the heads of the common Typha or cat-tail. The issuance as imagos as early in the spring as April or May precludes the possibility of the larvæ of this generation feeding on the eggs of the bagworm, and clearly indicates that there must be another host to carry it through the summer. That the larvæ at this time are in some way associated with the Typha head is likely, but whether they are there as scavengers or preying upon some other insect whose habitat is the Typha head is not apparent.

In connection with the rearing of this moth it is interesting to note that a small chalcid, *Leucodesmia typica* How., which is recorded by Dr. Howard as a parasite of a small moth, *Dakruma coccidivora* Com., predaceous upon our larger scale insects (Insect Life, VII, p. 402), was also reared from the bags of the bagworm and is in all probability a parasite of *Dicymolomia julianis*.

EGGS AND STAGES OF THE LESSER APPLE WORM

(*Enarmonia prunivora* Walsh)

By Estes P. Taylor, *Entomologist, Mo. State Fruit Experiment Station, Mountain Grove, Mo.*

During the summer of 1908 the writer had an opportunity of observing the eggs of *Enarmonia prunivora* Walsh, which had not been previously known to entomologists. This insect, as was shown by Mr. Quaintance in a paper upon "The Lesser Apple Worm" read before the Association of Economic Entomologists at Chicago in 1907 and published as Bulletin 68, Part V, from the Bureau of Entomology, has been found frequently infesting the fruit of the apple and in many cases its work has been mistaken for the damage done by the codling moth. I find this condition to prevail in the orchards of Missouri.

In the paper cited the difference between the two species was plainly pointed out, so that there should be very little confusion in distinguishing the smaller fusiform flesh-colored larva of the lesser apple worm, with its brownish caudal comb-like structure, from the larva of the codling moth. The work of the former was also shown to be different in several respects from that of the codling moth and of course there could be no mistaking the two when the adult moths were compared. Neither Walsh in Illinois, who first studied the insect in this country in 1867 as the "plum-moth," nor Riley, who studied the insect in Missouri in 1869, mention ever having seen the egg. Fletcher,

Lugger, Webster, Newell, Simpson and Chittenden are also the authors of literature upon this species, but none make mention of having observed the eggs and in the more recent paper by Mr. Quaintance it is stated that the egg had not been observed.

The writer on June 19, 1908, at Olden, Mo., collected from the smooth surface of small apples and from the upper surface of apple leaves borne near fruit, eggs which were at the time taken to be those of the codling moth. At the time of collection some of these specimens were noted to be much smaller than others in the lot. Some of these smaller ones were placed in breeding cages at approximately out-door temperature. A number of the larvæ hatched and entered apples placed in position for them. Upon the emergence of the larvæ from the fruit several specimens resembling the larvæ of *Enarmonia prunivora* were isolated and in time yielded adults of this species. To verify the determination of the moths reared, specimens were recently submitted to Mr. August Busck of the Bureau of Entomology, who has, through the kindness of Doctor Howard, looked them over and found them to be this species.

The eggs upon apple trees, so far as I have observed, are deposited singly either upon the smooth surface of the forming apple or upon the upper or glabrous surface of the apple leaves. In this respect the oviposition habits of the moth upon apple is not unlike that of the codling moth.

The eggs when freshly laid appear as small semi-transparent yellowish-white spots, looking not unlike much flattened and very small drops of milk. In outline they are usually oval, fitting closely down upon the surface as convex disks. Specimens measured upon an average .68 mm. long by .53 mm. broad, which measurements show it to be a trifle more than one half the size of the egg of the codling moth. They show a similar reticulation of the surface. During incubation they seem to undergo practically the same changes in appearance as seen in the incubation of codling moth eggs. The egg, at first milky white, shows, after a few days, a pinkish ring, which is the outline of the embryonic larva within. A day or two before hatching the darker anterior and posterior ends of the larva show through the egg shell as a dark spot. The hatching period is probably about five or six days under average orchard conditions, but no eggs were seen when deposited, though they were found when still fresh and milky and from this stage hatched in four days.

Larvæ under observation spent upon an average of 17 days in the fruit from the time they were seen to hatch until they emerged for pupation. From 21 to 23 days elapsed from the time eggs hatched to

the emergence of the pink fusiform larvæ from the apple for coccoon spinning, and in one instance gave 24 days from the time the larva left the apple to the appearance of the adult moth, with an average actual pupal period of 12 to 16 days.

The total life cycle of the lesser apple worm was found to be approximately the same as for the codling moth. Eggs of the lesser apple worm obtained in the orchard on June 19 hatched June 22–23. These yielded an adult moth August 7–8, or a period of 45 to 47 days from egg hatching to adult, which, with the addition of the time spent in the egg, places the total life cycle from egg laid to adult moth at approximately 7 weeks.

Apples were collected in the orchard on June 10 and placed in cages, which yielded an adult between July 11 and July 13, so it is quite probable that eggs of *Enarmonia prunivora* were already being laid in the orchard late in May, at which time apples of standard winter varieties measured from 1 to 1½ inches in diameter. At this date eggs of the first generation codling moth were numerous. Since many of these first generation lesser apple worms do not enter at the calyx but at the stem or side, an arsenical spray seems to be necessary when the apples reach the size indicated. As applications at about this time are also necessary against the curculio and the larvæ of the codling moth, which enter the apple at other places than the calyx, special sprays against the lesser apple worm other than those aimed at curculio and codling moth do not seem at this time necessary in Missouri. The eggs of *Enarmonia prunivora* are, according to the writer's observation, laid a few days later than those of the codling moth, and this fact, in cases of great abundance of the lesser apple worm, would somewhat emphasize the importance of a spray at this particular time.

ARSENICAL POISONING OF FRUIT TREES

By Wm. P. Headden

There appeared in the April number of this journal an article by Dr. E. D. Ball under the title "Is Arsenical Poisoning Killing Our Fruit Trees?" An address on this subject by Dr. Ball appeared in the *Desert Farmer* of February 27, of which the present paper is an abstract. Subsequent to the publication of the address Doctor Ball wrote to me disclaiming the personalities in the article in the following language: "This article is intended to be in no way personally controversial" . . . and in closing he adds, "Trusting that you will

interpret my motives, as I interpreted yours, that is, as an impersonal attempt to present the truth as you see it," etc.

I was glad to receive this wholly voluntary statement from Doctor Ball, for the impression made by the original article and this abstract of it is unfortunately both personal and controversial. The reader of either article will certainly infer from its general tenor as well as its language that my judgment in this matter is not entitled to serious consideration, to quote his own words, "Doctor Headden is not, however, a horticulturist or a plant pathologist . . . and his conclusion . . . is open to serious question." This in fact seems to be the weightiest argument produced why the conclusions of Bulletin 131 of this station should be seriously called in question.

Next to the preceding in importance is the allegation that I have based my conclusions on insufficient facts. He says, "It might also be well to state that the conclusions of the Colorado bulletin are apparently based upon few observations in the field, the greater amount of work having been done in the laboratory hundreds of miles from the spot where the damage occurred." Further in his conclusions he states, "That the entire subject of arsenical poisoning is a matter for careful and exhaustive investigation and any statements preceding that investigation should be of the most guarded nature."

Such statements are certainly unfortunate if the article is not personal, and is not controversial.

I am not quite clear as to what Doctor Ball's object is in these articles. I cannot find in either of them that he has made any investigation of the facts presented in Bulletin 131 of this station. He seems to be willing to accept my chemical findings but wishes to deny my conclusions without good reasons. He seems to be motived principally by a desire to defend the use of arsenical sprays by asserting that arsenic cannot be the cause of the death of certain trees, which he thinks were killed by something else. This is certainly not reasonable, for I have not attacked the practice of spraying but have simply pointed out certain injuries which it has already produced and given warning of the serious dangers attending the application of arsenicals to our trees, especially in the excessive amounts heretofore used. Doctor Ball seems to object to my doing these things without any further reason than that he seems to think that it is a naughty thing for me to do, and accordingly delivers himself as follows: "If, on the other hand, he is mistaken in his conclusions, the publication is most unfortunate, as it will no doubt cause a decided reaction against a now highly successful method of spraying and bring consequent financial loss to the fruit industry."

I took this and much more into consideration before I wrote Bulletin 131, but the conclusions at which I had arrived seemed to me to be far-reaching enough to justify their publication, whatever the immediate results might be. I was fully aware that many orchardists might offer opposition to further spraying, especially if they have been slow in recognizing the benefits of the practice. For such reasons I was more than ordinarily careful about my facts and was not hasty in my conclusions, nor did I permit myself to draw conclusions which are broader in their scope than the facts on which they are based justify, as is intimated throughout Doctor Ball's articles. The only statements which I can find in his articles that in any way tend to invalidate any statement made by me are those pertaining to my incompetency to determine the facts.

Doctor Ball does not attempt to show that the trees that I described were not killed by arsenic, but alleges that alkaline ground waters are killing trees in Utah, and concludes that the trees described by me were also drowned or killed by alkali. That trees may be drowned is a generally known fact. What the action of our alkali may be on ten or fourteen-year-old trees is an open question not so easily disposed of as one might imagine from Doctor Ball's statements. This question, so far as the statements of Bulletin 131 are concerned, is easily disposed of, for at least five of the orchards from which trees were taken are on mesas, where seepage is impossible, and none of the trees were taken from seeped lands.

Doctor Ball's comparison of the conditions in Utah and in the lower and heavier lands between Fruita and Palisade is not just because it leads the reader to conclude that the trees described came from such lands, which is not true. Indeed, some of the orchards referred to in Bulletin 131 have never had what may be called an abundant supply of water. One of the pear orchards described is above the highest ditch in that section, a wheel being used to raise the water for irrigating the orchard. Doctor Ball is acquainted with some of these orchards, which for obvious reasons I cannot specify, but he does not seem to have considered the conditions obtaining in them. Again, while it is true that there is some seeped ground between Fruita and Palisade and that some trees have been drowned, which fact I observed at least fourteen years ago, I described no tree in Bulletin 131 which I knew or believed to have been drowned. Besides, this country is in no such bad condition as the doctor's statements would lead one to infer. I have seen trees in this section which were dying, the main lateral roots were dead, the crown was girdled beneath the the ground and the roots showed the presence of much arsenic. The

soil is a sandy loam and the water plane at the shallowest point is eight feet below the surface. I have met with cases of arsenical poisoning as described in Bulletin 131 at points where the water was 75 feet below the surface on a mesa 150 feet above the river bottom. All of the doctor's statements may be entirely true for what he has seen in Utah but have no application to the facts set forth in the bulletin which he attempts to discuss.

Another point which he makes is that the readers of my bulletin are left to infer that arsenic is the only cause of death among our orchard trees. At the bottom of page 6, Bulletin 131, I make this statement, "I have already clearly indicated my conviction that the cause of the trouble is arsenical poisoning. That there are some trees suffering from other causes is quite certain, but the cause of the greater portion of the trouble is the arsenic which has accumulated in the soil." I marked this passage and sent him the bulletin and yet he says, "In fact nowhere in the bulletin can we find a statement that would lead us to believe that he knows of any cause of trees dying where no arsenical sprays have been used." I did not attempt to describe all sick or dead trees but only some for whose condition our station had been unable to find any cause known at that time.

Doctor Ball further states: "He (Headden) then examined the soil under the trees that had been sprayed and found arsenic present in considerable quantities, but in an insoluble form." The inference to be drawn from this statement is clearly that there is no soluble arsenic in the soil. This is wholly wrong, and if the doctor does not know it, he has utterly failed to get one of the most important points in the bulletin. On the first page of Bulletin 131 I state, "The protection against arsenical poisoning in the case of our orchard trees is the insolubility of the arsenical preparations used in spraying, and, further, that these preparations shall not be changed or become soluble in the soil." Again on page 8, "We find in fact what was from the beginning patent, namely that the arsenic does accumulate in the soil and is already present in our orchards in dangerous quantities, if it by any means should become soluble." On page 22 I state: "We have then direct proof that the alkali salts in the soil are capable of bringing the arsenic, even when present as lead arsenate, into solution and consequently making it a source of danger." Again in the summary I state: "The insoluble arsenical compounds are being converted into soluble ones in the soil."

Doctor Ball suggests that the Grand River water may be the source of the arsenic in the trees. He says: "This may possibly be the source of some of the arsenic found by Doctor Headden rather than

from the insoluble compounds used in spraying." One would infer from this statement, in fact in the original article he states, that "the entire district investigated by Doctor Headden is watered by irrigation canals taken from this stream . . ." This is not correct. A large part of the district investigated is not irrigated by Grand River water. I have made several complete analyses of the Grand River water and have never detected the presence of arsenic in it. As a fact there is no smelter, very little milling, if any, and only a very little mining carried on, either on the Grand River or its tributaries, above Grand Junction. But if the facts were in favor of his assumption this would not apply to those cases where the water comes from other sources, for instance from mountains where there are no known ore bodies and where the melting snows furnish the water, which flows but a short distance through a section where there are no mines, no mills of any kind, but simply volcanic and sedimentary rocks covered with forests of aspens and cedars. This suggestion is wholly gratuitous and without a shadow of foundation.

Doctor Ball diagnoses the affection of our trees and concludes that they are dying from a disease which he designates as "collar rot." Doctor Ball states that I am not a horticulturist nor a plant pathologist, but he evidently assumes to be both and to express an expert and final judgment without knowing very much, if anything, about the facts in the case.

There is no resemblance between our corroded crowns and the King disease, known as collar rot. Neither Mr. Whipple nor Professor Paddock, who are by profession horticulturists and plant pathologists, have been able to recognize this trouble as similar to any known disease, though they have had it under observation for five or six years, but Doctor Ball, who, so far as I know, has never seen a case of this affection except in the collection of samples which I gathered and used as the basis of Bulletin 131, passes judgment with a confidence which is refreshing. That he intends to assert the identity of the Utah and Colorado conditions is evident from his conclusion announced in the following words: "The only conclusion that it seems possible to draw from the facts cited is that arsenical poisoning cannot be the primary cause of either one of the above described conditions, and that therefore the main conclusion of Colorado Bulletin No. 131 is unwarranted."

Doctor Ball in describing the conditions on which the above conclusion is based cites three orchards with which he is familiar, especially one belonging to Lars Nording of Hyrum, Utah. If this case shows anything, it shows that the Jonathan is immune from the attack

of the disease which caused the death of the Ben Davis, his collar rot. He says: "As fast as a tree (Ben Davis) died, Mr. Nording replaced it with a Jonathan in the same hole and so far has not lost a single Jonathan." The same statement is made on page 146 of the JOURNAL, but the language is not so explicit. I state on page 6, Bulletin 131: "The varieties affected in this way are by no means confined to the Ben Davis and Gano. The following varieties are also affected: Spitzenberg, Early Harvest, Wolf River, Lawyer, Blacktwig, Baldwin, Jonathan, Grimes Golden and Pewaukee, and without doubt other varieties might be added if search were made to find every variety affected in this way. The trouble also extends to pear trees, but I have studied apple trees mostly." It is plain that I do not confine the trouble to the Ben Davis, and the fact is that we have more sick Jonathans than of any other single variety, and the most pronounced instances of corroded crowns, dead roots and darkened tissue are found in this variety.

To point out the effects of the admissions which Doctor Ball is kind enough to make in recognition of some points of value in the bulletin or to point out further how he has failed to see the force of the facts adduced (for instance, the relation between the presence of soluble arsenical compounds in the soil and the effect of the soluble sodic arsenite emptied into the ditch twelve feet from the tree) would make this answer too long, but there are still some things which I am justified in pointing out and that without the least personal feeling in the matter. The whole tenor of the article lacks frankness and in some respects is misleading,—for instance, that I spent too little time in the field to justify me in entertaining an opinion. This is a point on which he has no information.

The fact is that this difficulty with the trees had been under observation for four or five years by Mr. Whipple and Professor Paddock, the latter of whom, in particular, had repeatedly talked with me regarding the matter, as he knew my views in regard to the probability of danger from arsenical poisoning, and it was more than a year before the publication of Bulletin 131 that I began the actual field work.

Doctor Ball in the original article refers to a careful investigation that he made since the publication of Bulletin 131. This bulletin appeared in July, was distributed not earlier than August, and Doctor Ball had scarcely had the time to make a careful investigation. I have his own statement for it that this article was written in advance of careful experimental work. I am sure that it was not his intention to mislead anyone but that his zeal for the cause of arsenical spraying led him into making this unfortunate statement, unfortunate

not only because it is misleading, but because it is in strong contrast with his own statement, intended to apply to others as well as to myself, when he says: "The entire matter is one that calls for careful and exhaustive investigation and for cautious and guarded statements of any kind until the results of these investigations are known. Hasty and ill-advised statements with reference to the purity of arsenicals have already done a great injury to the fruit industry in the intermountain region."

The conclusions which he draws are not justified by any facts adduced. The fact that trees are killed by alkali water in Utah is no proof that trees planted in well-drained ground in Colorado should not die of arsenical poisoning.

In his second conclusion he fails to recognize my statement regarding the solubility of the arsenic in the soil.

His third conclusion, relating to careful and exhaustive investigations, hasty and ill-advised statements, etc., is a reiteration of a remark which I have already quoted several times and is one which any one with an ordinary acquaintance with the civilities of life will interpret as being very severe and as indicating that Doctor Ball exercised himself to say something real authoritative.

In conclusion I repeat: "I regret that I can see no other conclusion than that the corroding of the crowns, the killing of the bark, the staining and final destruction of the woody fiber, the early ripening of the leaves, presaging the early death of the tree and its final death a few months later, are caused by arsenical poisoning."

I shall in the course of a few months present another bulletin on this subject, which will show that Bulletin 131 is over-conservative on every point touching the action of arsenic, especially in regard to the systemic poisoning of our orchards. I can scarcely hope to be able to distinguish clearly between the action of lime and arsenic and the part that each may play. This statement is based on results already obtained, which I sincerely wish were other than they are, but they are so positive and serious that I venture to state that we must either find some other still more insoluble arsenical compound than any which has heretofore been used or find some other substance with which to combat the codling moth, or eventually render our trees so short-lived as to curtail the profits of orcharding.

NURSERY INSPECTION IN MINNESOTA

By F. L. Washburn, *St. Anthony Park, Minn.*

I am very glad to comply with a request of the editor and start the ball rolling in the direction of a series of articles from different nursery inspectors, showing how the work is carried on in various states.

Minnesota, of course, does not have the problems to combat present in many other states, which are partly or entirely in zones more conducive to the presence of insect pests on fruit and nursery stock. At the same time it is forging ahead as a fruit-growing state, the acreage is increasing yearly, and we have something like a hundred nurseries, many of which are doing a good business, and some of which have a very large patronage.

The nursery inspection law of Minnesota forbids the entrance into the state of any stock not properly certified. It does not oblige every nurseryman within the state to have his stock inspected, although it gives the entomologist of the experiment station power to inspect any stock on which he has reason to suspect the presence of an injurious insect or plant disease. Out of the approximately one hundred nurseries above referred to, inspection is asked for about sixty-five. This work is done either by the entomologist himself, or by his chief assistant, the latter last year doing a very large portion of the work in question. The law requires the nurserymen to bear the expense, and also to pay a fee to the inspector at the rate of $5 a day for the time occupied. This fee is turned in to the state at the end of the season. The work is simplified and the expense to the nurserymen lessened by grouping the nurseries, as far as possible, on circuits, each nurseryman on a circuit bearing his portion of the expense of inspection on that circuit.

A curious condition arises in connection with this work, no doubt met with commonly by other inspectors, from the fact that the law gives us no discrimination as regards what constitutes a nursery. A man may have only two or three hundred trees on a small piece of ground, which he simply rents, and the inspector may be reasonably satisfied that the nurseryman is not doing business on an honorable basis, and yet if he finds this man's trees free from pests, plant or animal, he has to give him a certificate, which can be used, of course, on any trees obtained from any source. We, however, protect ourselves in this particular by stating on the certificate that the same only applies to stock absolutely on the premises when examined.

As brought out in discussions at various times among inspectors, no

one can absolutely declare that the San José scale does not exist somewhere in a nursery. Should the Minnesota inspector or his deputy attempt to examine every nursery tree in some of our larger orchards or nurseries, it would mean anywhere from a three to six weeks' sojourn in one nursery. We probably pursue approximately the same plan adopted by other states: a block of trees is traversed in two or three directions, and the trees looked over first in a general way, and afterwards more in detail. If, however, any one tree, or more trees, attract attention on account of some peculiarity of appearance, those trees are given most careful scrutiny. So far we have never discovered in Minnesota any San José scale, although it has been present three years in Wisconsin, and we have known of its surviving two winters in South Dakota, and experimentally we have carried it through one winter in Minnesota, exposed to weather conditions. It is rather a surprising fact that with all the importation into this state during the past twelve years or more, we have not, in the six years of inspection, yet met this scale here. We fully expect to run across it before long, and the inspection for that and other reasons is becoming more rigid every year. The presence of San José scale, of course, disqualifies, as does also Crown Gall and Wooly Aphis.

Our inspection season lasts from May 1st to September 15th. Minnesota nurserymen are almost without exception on the most friendly terms with the inspector, and many happy hours have been spent in their company and at their hospitable homes. It must be said, however, that a great many of them look upon inspection as a humbug, in a mild way, a necessary nuisance, as it were, which has to be endured on account of the laws of other states into which they ship, but I think that within the past year, since the danger in importing foreign stock has presented itself, the sentiment in favor of careful inspection is growing. In this connection it may be said that we have been very much surprised at the amount of stock coming from Europe into Minnesota. When the alarm was first sounded this spring we sent letters to nurserymen, asking for information regarding any expected shipments, and were very much surprised to hear from one large nursery that a shipment from France was expected, and later on, work in this connection having been established with Dr. Howard and with the State of New York, we have been enabled to be advised of, and to examine, a large amount of this stock both from Holland and France, something less than a hundred boxes all told, up to the date of writing. We have found absolutely nothing in these shipments in the shape of the Brown-tail Moth caterpillars, Gypsy Moth eggs, or any other pest.

NURSERY AND ORCHARD INSPECTION IN MARYLAND

By T. B. Symons, *State Entomologist, Md.*

The introduction into Maryland in 1894 of the San José scale and its gradual spread during the last decade, threatening the fruit interests of the state, caused the passage of a law by the Maryland legislature in 1896 and additional amendments to said law in 1898, establishing the State Horticultural Department and creating the offices of State Entomologist, State Pathologist and State Horticulturist, and making these officers Professors of Entomology, Pathology and Horticulture respectively at the Agricultural College and Experiment Station. The purpose of the law as set forth was to suppress and eradicate the San José scale, peach yellows, pear blight, and other dangerously injurious insect pests and plant diseases throughout the State of Maryland. The enforcement of the law was placed under the control of the Board of Trustees of the Maryland Agricultural College and Experiment Station, to whom the officers created under the act are responsible.

The law specifically sets forth the duties of the State Entomologist and State Pathologist in conducting their work for injurious insects and plant diseases. It orders the inspection of all nurseries in the state at least twice a year by said officers, and directs that the officers visit each county in the state at least once a year for the purpose of determining by inspection the healthfulness and general condition of the horticultural and agricultural interests. Full power is given these officers to enter upon any public premises and to cause effective treatment of any plants and trees that may be found infested by an injurious pest, prescribing the method of procedure in conducting such inspections. The law prescribes that no trees, plants, vines, shrubs of any character can be sold within or without the state unless accompanied by a certificate of nursery inspection. It further precludes the introduction of any nursery stock from any other state or territory without the acceptance by the above officers of the certificate on such shipments. Eight thousand dollars has been the annual appropriation to the State Entomologist and State Pathologist for the conduct of this inspection work. It is only necessary for the purposes of this article to state the conditions under which this work is carried on in the State of Maryland at this time.

Nursery Inspection

There are at present fifty-two nurseries in the state from which plants and trees of various descriptions are being sold annually. While this is a rather small number of nurseries, yet there are included some of the largest nursery firms in the country. The output from the nurseries of Maryland aggregates approximately 35,000,000 trees and plants annually. As prescribed by law, the inspection of the nurseries is conducted conjointly by the State Entomologist, State Pathologist and their respective assistants.

The law prescribes two inspections annually, but it is only to the principal one of these that I will refer in these remarks, namely, the inspection of the nurseries conducted in late summer and early fall. This inspection is not commenced until after August 20th, as in our opinion a certificate issued on an inspection made before this date in this latitude would be of little value, since in the case of San José scale, for instance, there would yet be time for two or three broods of the insect and consequent dissemination of the pest before the cold weather of fall. The inspection therefore is conducted as late as possible in order to be completed in time for fall trade. It can be stated that the inspection in this state is conducted as thoroughly as circumstances and funds will permit. It is obviously impossible for the inspectors to examine every salable tree in a nursery, especially in nurseries of the size indicated above. It only remains for the inspectors to go through the blocks as thoroughly as possible, satisfying themselves as to the condition of the trees. We usually arrange to go through the blocks in a direction at right angles to the rows with an average distance of twenty to thirty feet between inspectors. Thus examining trees closely from the ground up in each row at this distance apart, the inspectors will invariably detect the presence of any injurious pest. In our experience we have not as yet had develop later a single case of infestation by an injurious pest which we had not located during the inspection.

Upon detecting the presence in a block of trees of any injurious pest likely to be dessiminated, we at once closely inspect surrounding stock and blocks. The trees found infested are immediately destroyed and no trees are allowed to be sold from blocks in which infested trees were found until after a hand inspection of all trees is made. As a further precaution, all trees sold from the nurseries in Maryland are required to be carefully fumigated with hydrocyanic acid gas. Thus we believe that the inspection of nurseries in this state is conducted on as high a plane as is practicable and that such inspection affords

as much protection to the orchardists and other growers, as well as to the nurserymen themselves, as is practical in the operation of such a law.

The State Entomologist and State Pathologist make it a point to do the inspecting of nurseries personally with the help of their regular assistants and the forces are divided only in the case of the very small tree nurseries or those that raise simply strawberries or like plants. Thus we aim to learn the exact conditions ourselves and follow up any prescribed treatment after such inspection. No certificate is granted to a nurseryman until after he has signed a written contract to the effect that he will not sell any trees that may be badly affected by wooly aphis or crown gall; and if the San José scale should be detected, his contract includes a close hand inspection of the stock from such infested blocks. Thus we aim to give the orchardists as good a guaranty as possible under existing conditions, that the stock they receive from Maryland nurserymen can be considered as free from such pests as similar stock from the nurseries of any state in the East. It is only fair to state in this connection that the Maryland nurserymen readily comply with the requirements made by the officers charged with the enforcement of the law.

Additional inspections were necessary this past spring on account of the finding of Brown-tail moth nests upon imported stock. Over 1,125,000 seedlings and other nursery stock have been carefully inspected during the past three months in this state. In all about 700 nests of the Brown-tail moth have been destroyed.

Orchard Inspection

As mentioned above the Maryland horticultural law directs that the State Entomologist and State Pathologist or assistants visit each county in the state at least once a year for he purpose of determining by inspection the healthfulness and general condition of the horticultural and agricultural interests. For a time the officers of the department endeavored to visit as many parts of the state as possible, but this procedure, while being a great help, did not promote the work as was desired.

The employment of local inspectors to inspect orchards for San José scale and yellows was then undertaken. The inspectors were given a course at the Maryland Agricultural College to better fit them for the work. This scheme of orchard inspection was decidedly more satisfactory and continues to be the most effective plan of reaching all parts of a given territory. While it is possible to inspect only a part of the state each season, the work gradually covers the whole

state. The local inspectors have their allotted territory each year in their respective counties. They are thus enabled to visit each individual orchard and report its condition to the office of the department. They come in personal contact with the grower and can point out injury caused by any pest or disease and advise him as to treatment.

Furthermore, by this local inspection a better acquaintance with the conditions in each locality is acquired and we are enabled to give direct attention to direfully neglected cases and cause treatment either by showing to the owners the great necessity of the same or, if necessary, by enforcing the law.

Moreover, the local inspectors can explain the work of the department to the orchardists, and show them that our efforts are directed towards helping them in the protection of their trees and the production of good crops, rather than in seeing the law enforced. Twenty-seven local inspectors worked in Maryland last season.

Thus the inspection of nurseries and orchards is conducted in Maryland with little or no friction, and the horticulturists as a whole are ever ready to support the work of the department.

SOME HOST RELATIONS OF TICKS[1]

By W. A. Hooker, *Washington, D. C.*

In a paper presented at the meeting of the Association of Economic Entomologists last year, the host relations of ticks were briefly considered. At this time I propose to present some additional information and deductions that have been drawn. I wish to call your attention first to the fact that in Mr. Nathan Banks' "Revision of the Ixodoidea," which was issued in June, we now have a work by means of which the ticks of this country can be readily identified. In this work nine genera, thirty-eight species (one doubtful) and one variety are described from the United States, including Alaska. During the past year three undescribed species, one an Aponomma (a genus hitherto not known to occur in this country) and *Amblyomma dissimile* (a Mexican and Central American species) have been collected within our borders, thus bringing the total up to at least ten genera represented by forty-one species and one variety. Incidentally it should be mentioned that collections of this one variety (*Dermacentor par-*

[1]Presented at the Third Annual Meeting of the Entomological Society of America, held at Baltimore, Md., December 30 and 31, 1908.

umapertus var. *marginatus* Banks) from jack rabbits and cotton-tails, upon which it is commonly found in southwestern Texas, leads us to infer, from characteristic color markings, that it may be a valid species.[2] This then is a greater number of species than we find listed by Mr. C. W. Howard in his recent work on the South African ticks.[3]

Of the fourteen species and one variety occurring in this country whose life histories we have now nearly completely worked out, three species molt upon the host, the Cattle Tick and Tropical Horse Tick (*Dermacentor nitens*) passing both molts and the Spinose Ear Tick (*Ornithodoros megnini*) the first molt before dropping.

Early in the fall of 1907 the writer, accompanied by Mr. J. D. Mitchell, found after a careful examination of quail (*Colinus virginianus*), at Brownsville, Texas, a number of larvæ and nymphs upon the dorsum of the head. These were recognized at once as belonging to the genus Hæmaphysalis. From the fact that *H. chordeilis* was the only representative of the genus found in this country that had been reported as attaching to birds, it was thought that these ticks belonged to that species. In collections made later at D'Hannis, Texas, several larval skins were found attached to the heads of quail and field larks (*Sturnella magna neglecta*) in connection with larvæ and nymphs. The finding of these skins with the immature stages naturally leads us to conclude that they were shed by the species of tick with which they were found. The possibility of their having been shed by a little known species (such as the Aponomma recently discovered) must, however, be considered. An adult that developed from an engorged nymph collected at D'Hannis has been identified by Mr. Banks as *H. chordeilis*. Further collections made in Victoria County, Texas, by Mr. J. D. Mitchell and at Grand Cane, Louisiana, Quincy and Hawthorne, Florida, by the writer, have shown that in the fall of the year at least nearly all ground-feeding birds serve as hosts for the larval and nymphal stages of this tick. In the collection of these ticks the writer has accompanied several old hunters, none of whom had ever observed them upon that generally distributed game bird, the quail, and questioned the veracity of a statement to that effect until they were shown. That these ticks have not been collected from game birds may be explained, however, by their small size and the fact that a large percentage leave the host even before the blood coagulates. The percentage of infestation of quail is shown to be large from the

[2]Since this paper was prepared Mr. Banks has examined recent collections and informs me that he now considers this tick to be a distinct species.

[3]Twelve genera, thirty-three species and six varieties are listed.

following report, made by Mr. J. D. Mitchell, of collections in Victoria County, Texas, in December, 1907: "On December 19 I shot twelve quail, each of which, as soon as killed, was placed in a clean white sack. The first examination was made thirty minutes after death, when sixty-five ticks were found in the sack. The other eleven birds were apparently equally infested. Upon removing the birds from the sacks more than five hundred ticks were collected. That there were 1,000 ticks upon the twelve quail would be a conservative estimate." In a collection of ticks received by the Bureau of Entomology from Prof. F. L. Washburn was found a Hæmaphysalis nymph labeled as taken from a Harris sparrow (*Zonotrichia querula*) at St. Anthony Park, Minnesota. Thus it is seen that this tick is nourished and disseminated in great numbers by these hosts in a large part of the United States. Unfortunately we are unable to distinguish *leporis-palustris* from *chordeilis* in the immature stages. As an adult specimen of *chordeilis* has also been collected in Victoria County, Texas, from a quail, we feel justified in concluding that at least a portion of these immature ticks belong to that species. While, with the exception of an engorged female reported as taken from a horse in Texas by Dr. Cooper Curtice, *H. leporis-palustris* has never been reported as taken from hosts other than hares and rabbits, it is not too much to suppose that the immature stages of this tick, so common on these hosts, also attach to birds.

During the past year two adults of a new species of Aponomma[4] have been collected by Mr. J. D. Mitchell, one an engorged female from a dog at Corpus Christi, Texas, the other a partially engorged female from a rabbit at Refugio, Texas. Several engorged nymphs and numerous unengorged larvæ of apparently this same species were collected by the writer in December, 1907, from quail at Hawthorne, Florida, thus showing that this species is widely distributed throughout the southern part of the United States.[5]

Larvæ and occasionally engorged nymphs of a species of Ixodes, probably either *Ixodes scapularis* or *cookei*, have been found by the writer attached to birds at Grand Cane, Louisiana, and Hawthorne, Florida, on blue jays (*Cyanocitta cristata*) and at Quincy, Florida,

[4]Since described by Mr. Nathan Banks as *A. inornata*.

[5]The fact that molted larval skins have been found on birds in Texas in connection with the immature stages of Hæmaphysalis and not on birds in Florida in connection with the immature stages of Aponomma surely is strong circumstantial evidence. This habit will soon be determined, however, either by the collection of perfect skins or from the breeding of seedticks that have hatched from eggs deposited by one of the type specimens.

upon an undetermined species of thrush. An engorged nymph was taken by Mr. J. D. Mitchell in Victoria County, Texas, from a quail. In Prof. F. L. Washburn's collection there is a male specimen of *Ixodes cookei* labeled as taken at St. Anthony Park, Minn., from a robin (*Merula migratoria*).

We have also found that birds serve as hosts for at least two American species of Amblyomma. *Amblyomma americanum* larvæ, unengorged and partially engorged, in large numbers, also a male specimen, were taken in Kerr County, Texas, from a chaparral cock (*Geococcyx californianus*) by Messrs. W. D. Hunter and F. C. Pratt in August, 1907. Thus we find a bird disseminating a species that is of economic importance. But little has been known of the life history and habits of *Amblyomma tuberculatum* except that it is found upon the gopher tortoise (*Testudo polyphemus*) in Florida. Recently Prof. H. A. Morgan has informed the writer that he has seen a specimen of this tick that was collected in southern Alabama. The writer has collected the engorged larvæ in large numbers from dogs and from a cotton-tail rabbit at Hawthorne, Florida, and larvæ that were collected from cattle at Sorrento, Florida, have been received from Mr. P. B. Powell. In January of the present year several specimens of engorged larvæ were collected from the head of a sparrow hawk (*Falco sparverius*) by Dr. E. A. Back of the Bureau of Entomology. During an examination of the Bureau of Entomology collection the past winter, the writer found three poorly preserved specimens of engorged larvæ taken from an owl in Florida, which are undoubtedly *A. tuberculatum*. The fact that they have only been found upon birds of prey suggests the idea that they crawled to the bird-host from the rabbit or other small mammal being devoured. In life history work nymphs of this species have been found to attach readily to and engorge upon a bovine. To summarize: The larvæ of *A. tuberculatum* have been taken attached to mammals and birds. The nymphs are commonly found on the gopher tortoise and have experimentally engorged upon a bovine, while the adults will apparently attach to cold-blooded animals only. We have found this species when engorged to surpass in size the African species *Amblyomma hebræum* and *Hyalomma ægyptium*, one gorged female having measured nearly an inch in length, actually measuring 24.0 mm. long by 18.5 mm. wide.

Thus we find birds acting as hosts and disseminators in this country of the immature stages of a number of species, representing the genera Amblyomma, Hæmaphysalis, Ixodes, and probably Aponomma. Habits of this nature may account for the wide distribution of *A. americanum*, *H. leporis-palustris* and other species, the migratory ter-

restral birds probably playing the more important rôle in their dissemination.

Amblyomma dissimile is a species found on iguanas in Central America and Mexico. During the past year it was collected at Brownsville, Texas, by Mr. H. P. Wood of the Bureau of Entomology from iguanas that had been brought from the isthmus of Tehuantepec for exhibition purposes. It is supposed that the host relations of this species are similar to those of *A. tuberculatum*, for nymphs as well as adults were collected from the iguanas. Larvæ and nymphs have attached to and engorged upon a bovine, but adults would attach to a cold-blooded host only.

Fortunate it is that birds do not play the rôle of host to the Cattle Tick, else our national campaign of extermination would be in vain. As far as we know, except in the case of *A. americanum*, these bird-host relations are not of economic importance in this country, at least at the present time. Should a tick-borne disease be introduced and one of these species become implicated, birds might be an important factor in its spread.

Aside from some of the larger mammals, the host relations of the Spotted Fever Tick (*Dermacentor venustus* Banks) still remain to be determined.[6] During the past year we have found all stages of this tick to engorge upon a bovine. While there are no records of birds serving as hosts for any species of Dermacentor, such a possibility, as well as that of reptiles and batrachians, must be considered. Suspicion is most naturally placed upon the small mammals as harborers of the spotted fever infection, since it seems most probable that they serve as hosts of this tick and play an important rôle in its dissemination. Dr. H. T. Ricketts in connection with his investigation of the disease and Prof. R. A. Cooley,[7] as the entomologist of the state in

[6] A report by Doctor Ricketts of investigations made during 1907 and 1908 into the cause and prevention of Rocky Mountain Spotted Fever in the Bitter Root Valley of Montana has recently appeared (February, 1909). In it Doctor Ricketts states that he has found by inoculation that the gopher, rock squirrel, wood chuck, chipmunk, and mountain rat are susceptible to the disease and also serve as hosts for the Spotted Fever tick. Experiments with the tick are said to indicate that at least the first four of these hosts may, when acting in conjunction with the tick, be effective in maintaining the disease by causing its extension among the ticks. The host or hosts of the infection in nature, however, has not as yet been discovered.

[7] In a report of his investigations of the Spotted Fever Tick in 1908, which appeared in April, Prof. R. A. Cooley includes data on its host relations. All of six Rocky Mountain Pikas (*Lagomys princeps*) and two of the twelve chipmunks (*Tamias quadrivittatus ameonus*) collected had immature ticks upon them. None were found upon any of twenty Red or Pine Squirrels (*Sciurus hudsonicus*) collected.

which the disease is most widespread, are now investigating the life history and habits of this tick and we may soon look for important developments. It is of course necessary that the host or hosts which harbor the infection in nature be discovered before it can be determined whether preventive measures will consist in dealing with the animal or animals that harbor the infection or with the tick that transmits it. In order to determine the source of this infection, it appears to be necessary that ticks, either sufficiently engorged to molt or to deposit eggs, be collected from their various host species and engorged in the following stage or stages upon a susceptible host, such as the guinea pig. When we consider that the mortality from the disease is as high as 70 per cent, the danger that is entailed in the investigation is at once appreciated.

The brilliant work of Dr. H. T. Ricketts in connecting the tick now known as *Dermacentor venustus* with the transmission of the disease has well been rewarded in the award of a gold medal by the American Medical Association at the annual meeting held in June.

Even field mice appear to play a rôle in the multiplication and dissemination of ticks. During the recent examination of the Bureau of Entomology collection an engorged larval specimen that appeared to be *Dermacentor variabilis* was found with a label to the effect that it had been collected from the nest of a field mouse near Washington, D. C. It will undoubtedly be found the world over that birds and small mammals serve as hosts for the immature stages of various Ixodid ticks. In a country like Africa, where numerous tick-borne diseases obtain, the importance of these habits will at once be appreciated. That more has not been learned concerning them is due in part, as before stated, to their small size and the fact that they readily escape notice in the thick fur and feathers or drop before an examination can be made. There is much that remains to be learned about these relations through a more extensive collection, and it is hoped that entomologists and other collectors may extend their activity in this direction.

In connection with life history studies, geographical and host lists are being prepared in connection with which this subject will be considered more extensively. Any collections, records or data on the subject will be gratefully received.

Since this paper was presented a work entitled "Interim Report on the Parasites of Grouse," by A. E. Shipley, has come to hand, which gives some important information concerning the host relations of the European Castorbean Tick (*Ixodes ricinus*) in England. On page 5

of this work Professor Shipley says: "The larvæ and the nymphs are common enough on birds, lizards, and small mammals—in fact, on animals which live among and brush through grass or heather. It is only in the nymph and larval state that we find these ticks on the grouse. On each of the infested birds the specimens were fixed on the chin or round the eyelids—in fact, in such positions as the grouse cannot reach with its beak. In parts of Ross-shire, especially in certain woods, these ticks swarm in enormous numbers, and the keepers assure us that they kill large numbers of young blackgame. Hence there is nothing remarkable in finding this species from time to time on the grouse, where its presence must be regarded as accidental. The larval stages emerge from the eggs and probably crawl on to the heather, and thence on to the grouse or other animals which come in contact with the vegetation. We have found both larvæ and nymphs among the feathers, but in small quantities and on rare occasions. We have never found it in the crop, and it can hardly play any part in infecting the bird with tape-worms. . . . This tick occurs most frequently during the spring and early summer, but disappears after the beginning of July."

Scientific Notes

Further observations on Contarinia. The writer last June (Journ. Econ. Ent. 1 : 225–227) summarized our knowledge respecting the economic status of this genus. In the following issue (p. 243) he recorded serious injuries to early Moore grapes in the Chautauqua region by a species then designated as *Cecidomyia johnsoni* Sling. This spring we fortunately succeeded in obtaining the adult and found it to be a Contarinia. Furthermore, an examination of foreign literature shows that a European grape pest, *Contarinia viticola* Rubs., a species which has caused considerable damage in European vineyards, may be the same as the earlier characterized American form. Should further investigation prove this to be true, we have in this species another introduced pest. There is no forecasting the future place of this species as an American insect of economic importance. Our knowledge of the genus is such as to justfy regarding this grape blossom midge with grave suspicion. It adds to the number of destructive species of Contarinia and further emphasizes the practical importance of the genus. Full descriptions of the two sexes, together with an account of the insect, will appear in the writer's report for 1908.

E. P. Felt.

Nodonota punticollis Say was very abundant and injurious on rose bushes this season (June 8) at Ardmore, Montgomery County, Pennsylvania. Some of the flowers have as many as fifteen of the beetles feeding in them and the roses are rapidly destroyed.

Henry Skinner, M. D.

JOURNAL OF ECONOMIC ENTOMOLOGY

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The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints of contributions may be obtained at cost. Minor line figures will be reproduced without charge, but the engraving of larger illustrations must be borne by contributors or the electrotypes supplied. The receipt of all papers will be acknowledged.—EDS.

It is a pleasure to include in this number two articles on methods of nursery inspection. We trust that they will provoke discussion and lead to a full and frank consideration of the more important problems arising in this branch of applied entomology. The importation last winter of many shipments of nursery stock bearing winter nests of the brown-tail moth aroused the country to the importance of nursery inspection. Unfortunately the inspection officials of various states were limited by political boundaries and could go no farther than is possible through mutual coöperation. We believe everything was done that was feasable to locate shipments of infested stock and to destroy the pests. Nevertheless, the necessity of national inspection or quarantine regulations made itself apparent to everyone conversant with the situation. Exclusion is immensely cheaper and much more satisfactory than suppression after a pest has become well established. The annual cost of fighting the gipsy moth in the restricted New England areas infested by this pest now amounts to much more than would suffice to maintain a thoroughly adequate national quarantine. The gipsy moth is only one among many imported insects, some of which have become widely established throughout the country and annually cause enormous losses. Furthermore, no one can foresee the time when some other very destructive pest will become established in this country. Nursery inspection, if it is to survive, must justify itself by excluding injurious species, or at least by preventing their unrestricted dissemination throughout the country. We all admit the desirability of national quarantine. A bill providing for this was before Congress last winter and was defeated because certain features were objectionable to nurserymen. The entire proposition should be thoroughly canvassed and an effort made to work out a harmonious solution which will afford maximum protection with minimum annoyance and loss.

An extraordinary campaign against the typhoid or house-fly is now in progress. Magazines, weeklies and dailies are cheerfully giving much space to exposing the true character of the insect. Satire, denouncement and exhortation are all being employed. Municipalities here and there are adopting much needed sanitary regulations designed to reduce the numbers of this nefarious fly. The Merchants' Association of New York City and some other associations, as well as numerous individuals, are giving much time and effort to this most commendable work. The control of this insect is an entomological problem, since efficient repressive work must be based upon adequate knowledge of the habits of the fly and the way these may be taken advantage of to reduce the numbers of the pest in the most economical manner. The sanitarian and the medical man are both in position to give cogent reasons for the suppression of this long tolerated menace and nuisance. Special pains should be taken to encourage every good feature of the movement and at the same time care exercised to avoid everything which may appear like an overstatement of facts. This campaign, if it is to be successful, must be conducted along common sense lines and the necessity of attending closely to details emphasized most strongly. Otherwise there may be a disappointing reaction, which may result in a serious set-back to home sanitation, not to mention the continuance of needless suffering and loss of health and life.

Reviews

Ticks, a Monograph of the Ixodoidea, by G. H. F. NUTTALL, C. WARBURTON, W. F. COOPER and L. E. ROBINSON. Cambridge Univ. Press, First Part (Argasidæ), 104 p., 114 figs., 3 pls.

This part of the work, which has just been issued, is far from our expectations. It is not a monograph in any sense of the word. The authors have not used the great collections of Doctor Neumann, of the Paris or Berlin museums, all of which are so easily accessible to them, and of the utmost importance to anyone studying the ticks of the world. Consequently a number of species known to Doctor Neumann are unknown to them, and of those that they have examined one is struck by the paucity of specimens. Under each species there is a full bibliography and iconography, a brief technical description (in many cases more or less compiled), and as much matter on the habitat and geographical range as can be obtained from the literature. There is an interesting chapter on the biology of the Argasidæ, almost wholly compiled, and an extensive bibliography. Most of the figures are taken from Neumann. The plates are original. N. BANKS.

The Lesser Apple Leaf Folder, by R. L. WEBSTER. Iowa Agric. Exp't Sta. Bull. 102, p. 179–212, 1909.

This admirable biological study, illustrated by a number of original figures and plates of a comparatively little known insect, *Peronea minuta* Rob., makes material additions to our knowledge of this species and methods of controlling it. The arrangement of the matter diverges from the usual, in that a discussion of control measures follows the account of its injuries, the portions treating of classification, the life history and the discussion of natural enemies being relegated to a less conspicuous part of the bulletin.

Scale Insects of the Orchards of Missouri, by E. P. TAYLOR. Mo. St. Fruit Exp't Sta. Bull. 18, p. 1–87, 1908.

This is a general discussion, with special reference to the San José scale and the more destructive scale insects of the orchard, together with a few allied forms, such as the grape scale, *Aspidiotus uvæ*, walnut scale, *A. juglansregiæ*, and the cottony maple scale, *Pulvinaria innumerabilis*. A number of experiments with the San José scale are summarized, the author giving decided preference to lime-sulfur washes though admitting the usefulness of miscible oils. This summarized account will be particularly serviceable to fruit growers.

The San Jose Scale in Arkansas, by C. F. ADAMS. Ark. Agric. Exp't Sta. Bull. 102, p. 221–236, 1908.

This summarized account, designed especially for fruit growers, discusses in some detail remedial and control measures, giving particular attention to nursery inspection and the necessity of a better law for regulating the same.

Lime-Sulfur Mixtures for the Summer Spraying of Orchards, by W. M. SCOTT. U. S. Dep't Agric., Bur. Plant Indust. Cir. 27, p. 1–17, 1909.

This summarizes to date the status of these preparations as summer sprays. Professor Scott restricts his circular to statements of the results obtained in controlling fungous diseases affecting peach, cherry and apple, comments upon the injury to the foliage from these preparations and with commendable conservatism allows fruit growers to draw their own conclusions.

The Hop Flea Beetle, by F. H. CHITTENDEN. U. S. Dep't Agric., Bur. Ent. Bull. 66, Prt. 6, p. 71–92, 1909.

This is a detailed account, with numerous original illustrations, of the hop flea beetle, *Psylliodes punctulata* Melsh., a species quite injurious to hops on the Pacific coast. Notes are given on a number of related species. There is an extended discussion of control methods, including several new mechanical devices for the capture and destruction of the pests.

The Grapecane Gall Maker and the Grapecane Girdler, by F. E. BROOKS. W. Va. Agric. Exp't Sta. Bull. 119, p. 321–39, 1909.

These two little known insects, *Ampeloglypter sesostris* Lec., and *A. ater* Lec., are discussed in detail, the accounts being illustrated by an admirable

series of original figures and process reproductions. The author is to be congratulated upon having made substantial additions to our knowledge of these two forms.

The Semitropical Army Worm, by F. H. CHITTENDEN and H. M. RUSSELL. U. S. Dep't Agric., Bur. Ent. Bull. 66, Prt. 5, p. 53–70, 1909.

This bulletin gives in detail the life history and habits of *Prodenia eridania* Cram., a common southern injurious species which appears to have hitherto escaped notice to a large extent. The insect and its operations are admirably depicted by a series of original illustrations.

Whitefly Studies in 1908, by E. W. BERGER. Fla. Agric. Exp't Sta. Bull. 97 p. 41–71, 1909.

This is a revision of Bulletin 88, with important additions. A most interesting feature is the discussion of the various fungi affecting white flies and the description of a new species, *Aleyrodes nubifera*, previously confused with the common *A. citri*.

Biological Studies of Three Species of Aphididae, by J. J. DAVIS. U. S. Dep't Agric., Bur. Ent. Tech. Ser. No. 12, Prt. 8, p. 123–68, 1909.

An extended biological study of the corn root aphis, *Aphis maidi-radicis* Forbes, the corn leaf aphis, *Aphis maidis* Fitch and the sorghum aphis, *Sipha flava* Forbes. The life history of each species has been worked out in detail, the food habits, the number of generations and the productivity of each being indicated by a series of admirable tables. Each account is accompanied by an extended bibliography. The presentation of a large amount of data in such a concise and comprehensive manner is most admirable.

Economic Loss to the People of the United States Through Insects that Carry Disease, by L. O. HOWARD. U. S. Dep't Agric., Bur. Ent. Bull. 78, p. 1–40, 1909.

This comprehensive discussion from a broad viewpoint treats particularly of malaria, yellow fever and typhoid fever and the losses caused by the dissemination of these infections through the agency of certain insects. The chapter on endemic diseases and their effect on the progress of nations from Ross, with Doctor Howard's comments thereupon, is a most fitting conclusion to an admirable summary of the situation. This bulletin should be widely read by laymen as well as by professional men.

Fruit Trees and Their Enemies, with a Spraying Calendar, by SPENCER PICKERING and FRED V. THEOBALD, p. 1–113, 1908.

This is a summarized account, admirably printed on good paper, of the various enemies affecting fruit trees, including not only insects and fungi but birds, mammals and frosts. The introductory matter, while important, is relatively much more extended than the necessarily very brief discussions of the various species. Judged from the American standpoint, the work would

have been greatly improved by a series of figures showing the characteristics of the more important insects and fungous diseases. It will undoubtedly prove very useful to fruit growers of Great Britain.

The Warble Fly, by GEORGE H. CARPENTER and J. W. STEEN. Dep't Agric. & Tech. Instruct. for Ireland Journ. vol. 8, No. 2 Separate, p. 1–22.

This is a general discussion, illustrated by a series of excellent figures, of the warble flies, *Hypoderma bovis* and *H. lineata*. The details of a series of experiments with various washes and other protective measures are given, one of the most interesting being data showing that calves with the legs covered from June to September were infested on the average by only 3.5 warbles, as opposed to an infestation by ten warbles in the case of calves with the back and sides protected. The authors consider the destruction of the maggots as the most practical method of dealing with these pests.

Injurious Insects and Other Animals Observed in Ireland During the Year 1907, by GEORGE H. CARPENTER. Royal Dublin Soc., Econ. Proc., vol. 1, p. 559–588, 1908.

This comprises brief illustrated notices of many insects observed during the season, with somewhat extended discussions of the cattle tick, the scab and itch mites and the pear blister mite. The value of the report is greatly enhanced by a series of original process plates.

South African Central Locust Bureau, First Report of the Committee of Control, edited by CLAUDE FULLER, p. 1–112, 1907.

This is a noteworthy document in that it places on record the progress made by a group of administrations toward subduing a common enemy. The leader in this movement was the late C. B. Simpson, unfortunately deprived from taking an active part in the operations by an untimely decease. The official history dates from a dispatch June 1, 1906, and a conference held the following August between representatives of a number of administrations. This resulted in the drafting of a series of resolutions providing for a central bureau at Pretoria and its maintenance by contributions from the interested governments. Provision was made for a secretary and the tabulation by him or under his direction of data relating to the distribution and movements of locusts. The two troublesome species are the red winged locust, *Cyrtocanthacris septemfasciata* and the brown locust, *Pachytylus sulcicollis*. The need of coöperation was due to the swarms of locusts deserting extensive wild tracts for the more attractive cultivated areas. An interesting biological phenomenon is the persistence in the soil of viable eggs for a period of several years. The possibility of this, a matter of common belief, was recently determined by Professor Lounsbury. There is an interesting chapter on the food value of locusts. The destructive swarms are controlled most readily and economically by spraying the vegetation in their vicinity with a sweetened arsenical solution, precautions being taken to keep stock from the treated area till the arsenic has burned and killed the grass or until a heavy rain has washed it off. The problem of South Africa appears to be very similar to the locust evil of South America and to that which obtained in the West

some years ago. Several of the colonies have enacted a legislation designed to compel coöperation in the locust fight, while others provide assistance to individuals conducting a warfare against the common enemy.

Current Notes

Conducted by the Associate Editor

The Associate Editor has taken up work at the Gipsy Moth Laboratory, Melrose Highlands, Mass., for the summer and all communications should be sent to the above address and not to Washington, D. C.

Prof. Herbert Osborn has been granted leave of absence for one year at the Ohio State University and arrangements made for him to investigate certain insects injurious to cereal and forage crops for the Bureau of Entomology.

Mr. F. D. Couden of the Bureau of Entomology gave a short course on elementary entomology to the students at the Biltmore Forest School, Biltmore, N. C., during the month of May.

Prof. J. M. Stedman has resigned the position of state entomologist of Missouri to accept an appointment with the office of experiment stations, Washington, D. C.

Mr. C. T. Brues, curator of the Department of Invertebrate Zoölogy, Public Museum, Milwaukee, Wisconsin, has been appointed instructor in entomology at Harvard University vice Mr. Paul Hayhurst resigned. Mr. Brues will begin work in his new position September 1, and after that date his address will be Bussey Institution, Forest Hills, Boston, Mass.

Prof. W. M. Wheeler has in press a new book entitled "Ants, Their Structure, Development and Behavior," which is being published by the Columbia University Press. This book will appear early next fall, and will contain much new and valuable information concerning this interesting family of insects.

At the last session of the Ohio legislature an appropriation of $6,950 was made for the Department of Entomology of the Ohio Agricultural Experiment Station for the fiscal year ending March 1, 1910. Three assistant entomologists will be employed in the future. Mr. J. S. Houser has been appointed first assistant, while Mr. W. H. Goodwin and Mr. L. L. Scott will fill the other positions. Mr. Scott is a graduate of the Ohio State University and will take up an investigation of bark beetles injurious to fruit trees. Other imporant lines of work will be an investigation of spring and fall canker worms, the wheat joint worm, shade tree pests, the woolly aphis and demonstration work in spraying.

The total returns from one acre of Ben Davis apple trees at Erlin, Ohio, sprayed last year by the station entomologists amounted to $1,400 and the net profit was $1,000. Demonstration orchards will be treated this year in all sections of the state.

Prof. G. P. Clinton, Mycologist of the Connecticut Agricultural Experiment Station, has sailed for Japan for the purpose of studying the fungous diseases

which affect the gipsy moth, with a view to introducing them into the infested district in Massachusetts. The trip is being undertaken by Harvard University in coöperation with the state of Massachusetts, and it is hoped that the importations received will be of great value in decreasing the gipsy moth in badly infested sections.

The Department of Entomology of the University of California has for several years past held four conferences during the school year at stated intervals, the place alternating with Berkeley. Thus during the last school year four such conferences were held, two at Berkeley, one at Watsonville and another at Davis. The last of these meetings held in Berkeley was planned to be more inclusive, inasmuch as entomologists from the entire Pacific Coast were invited to attend and present papers. The hope was also expressed that a special organization of western entomologists might be effected inasmuch as the insect problems of the Pacific Slope are so different from those on the other side of the Rocky Mountains.

At this meeting, held April 20 to 23, the following general program was carried out: Tuesday afternoon (April 20), "Lime Sulfur, Its Use and Manufacture"; Tuesday evening, "The Manufacture of Miscible Oils and Arsenical Insecticides"; Wednesday morning (April 21), "The European Elm Scale and the Codling Moth"; afternoon, "The Orange Scale and the Citrus Mealy Bug"; evening, exhibits of insecticide materials, insect collections, apparatus illustrating methods of study, etc.; Thursday morning (April 22), visit to Oakland formicary; afternoon, "Forest Insects and Apiculture"; evening, "Medical Entomology"; Friday morning (April 23), "Methods Used in the Study of Sensory Reactions, Insect Photography"; afternoon, permanent organization.

The meeting was well attended notwithstanding the enormous distances separating the workers on the Pacific Coast. As had been hoped at the outset, a permanent organization was effected under the name of Pacific Slope Association of Economic Entomologists. The constitution adopted requires that active membership shall be limited to the official and professional entomologists of the Pacific Slope, while associate membership shall be open to agriculturists and to all others interested in the objects of this association. The following officers were elected, viz.: President, Professor C. W. Woodworth, University of California, Berkeley, Cal.; vice-presidents (representing each state concerned), Prof. R. W. Doane, Palo Alto, Cal.; Prof. S. B. Doten, Reno, Nevada; Prof. J. Elliott Coit, Phœnix, Arizona; Prof. Fabian Garcia, P. O. Agricultural College, New Mexico; Prof. E. D. Ball, Logan, Utah; Prof. A. B. Cordley, Corvallis, Oregon; Prof. A. L. Melander, Pullman, Washington; Prof. L. F. Henderson, Moscow, Idaho; Prof. C. P. Gillette, Fort Collins, Colorado; Prof. R. A. Cooley, Bozeman, Montana; Prof. Aven Nelson, Laramie, Wyoming; Hon. Thomas Cunningham, Vancouver, B. C. Executive Committee, Mr. R. R. Rogers, San Francisco, Cal.; Mr. H. P. Stabler, Yuba City, Cal. Mr. L. H. Day, Oakland, Cal.; secretary-treasurer, Prof. W. B. Herms, University of California, Berkeley, Cal.

It is planned to hold the next meeting this summer at Portland, Oregon, in conjunction with the American Association for the Advancement of Science.

W. B. Herms, *Secretary-Treasurer.*

Mailed June 15, 1909.